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FACULTY OF COMPUTING
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SECR1213

NETWORK COMMUNICATIONS

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NETWORK DESIGN FOR FACULTY OF COMPUTING BLOCK N28B

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1.0 INTRODUCTION

For this project, we were required to design the networking system for a new building. We were given a budget of RM 1.2 million to accomplish this task. This building will be mainly used for the teaching purposes of the Faculty of Computing to accommodate the projected increase of the number of students and academic staff in the upcoming time. This project is divided into 5 distinct phases, Task 1 until Task 5 and aims to enhance our understanding on different parts of networking design that we should explore and master as part of this course.

1.1 OBJECTIVE

The main objective of this project is to design and implement a comprehensive and efficient network infrastructure for a faculty building. This includes ensuring seamless connectivity, meeting the diverse needs of students and staff, and creating practical and functional spaces such as general purpose labs, CISCO lab, embedded lab, hybrid classrooms, and common areas. The project aims to provide reliable internet access, robust communication channels, and a well-organized network that supports current and future technological demands.

1.2 AIMS

1. To create a functional and practical layout for all spaces in the building, prioritizing accessibility and usability.
2. To design a robust and reliable network infrastructure that ensures seamless communication and connectivity for all users.
3. To implement industry-standard practices in network design, including structured cabling, IP addressing, and device placement.
4. To enhance technical knowledge and problem-solving skills through the research and application of network communication concepts.

1.3 SCOPE

The scope of this project covers the following key areas:

1. **Facility Design:** Planning and designing the layout of general-purpose labs, the Cisco Network Lab, Embedded Lab, hybrid classrooms, and common areas such as prayer rooms and lounges.
2. **Network Infrastructure:** Designing the network setup, including structured cabling, IP addressing, and the arrangement of switches, routers, and access points to ensure reliable connectivity across all spaces.
3. **Equipment Selection:** Researching and selecting appropriate devices such as switches, routers, cables, and video conferencing systems to meet the technical and budget requirements.
4. **Subnetting and Addressing:** Dividing the network into subnets and assigning IP addresses to ensure optimal utilization of network resources and logical device organization.
5. **Cost Analysis:** Calculating and optimizing the overall cost of equipment and installation to align with budget constraints while maintaining high-quality standards.
6. **Future Scalability:** Ensuring the network infrastructure can support future expansions and technological upgrades.

2.0 BACKGROUND

Task 1 requires us to plan a logical and sensible floor plan that will be used as a blueprint for the later phases of the project. The plan came with its own set of requirements, such as the number and type of labs that must be designed, the dimension of each lab, the number of floors the building will have and the number of workstations that will be hosted in each lab in addition to the extra amenities that the building should provide for lecture purposes. This floor plan will act as our learning material for the next phases.

For Task 2, we were required to do research on our own regarding designing a network connection in a building. The research came in the form of questions and answers, where we were directed to explore and find a few questions that are relevant regarding designing a network connection for a building. The answer must be researched, either in the form of scouring the internet or asking directly to our stakeholder in this project who is the faculty representative. The answer that is found will act as a general guideline for the later phases of the project.

Next, we were required to choose the necessary equipment in designing a network connection. In choosing the best devices, we did research on the different types of devices, the strength and weaknesses of each device, the reputation of the companies selling the devices and the price offered by said companies for their devices. To provide the best learning experiences, high quality devices are needed as the curriculum provided by the faculty requires a robust Internet connection and some hands-on learning for certain courses.

After that, in Task 4, we need to plan a physical connection for each of the devices that we have chosen in the previous task. We chose the optimal type of connection, the routing of the cables and calculated the length of the cables used.

In Task 5, we divide the network into proper subnets in order to provide optimal network connection and reduce the congestion experienced by future users. As different devices and work areas have different requirements for the network, we subnet the network into proper subnet division and provide the devices with a sensible amount of IP Address as usable hosts.

3.0 CONTENT

3.1 TASK 1

3.1.1 FLOOR PLAN

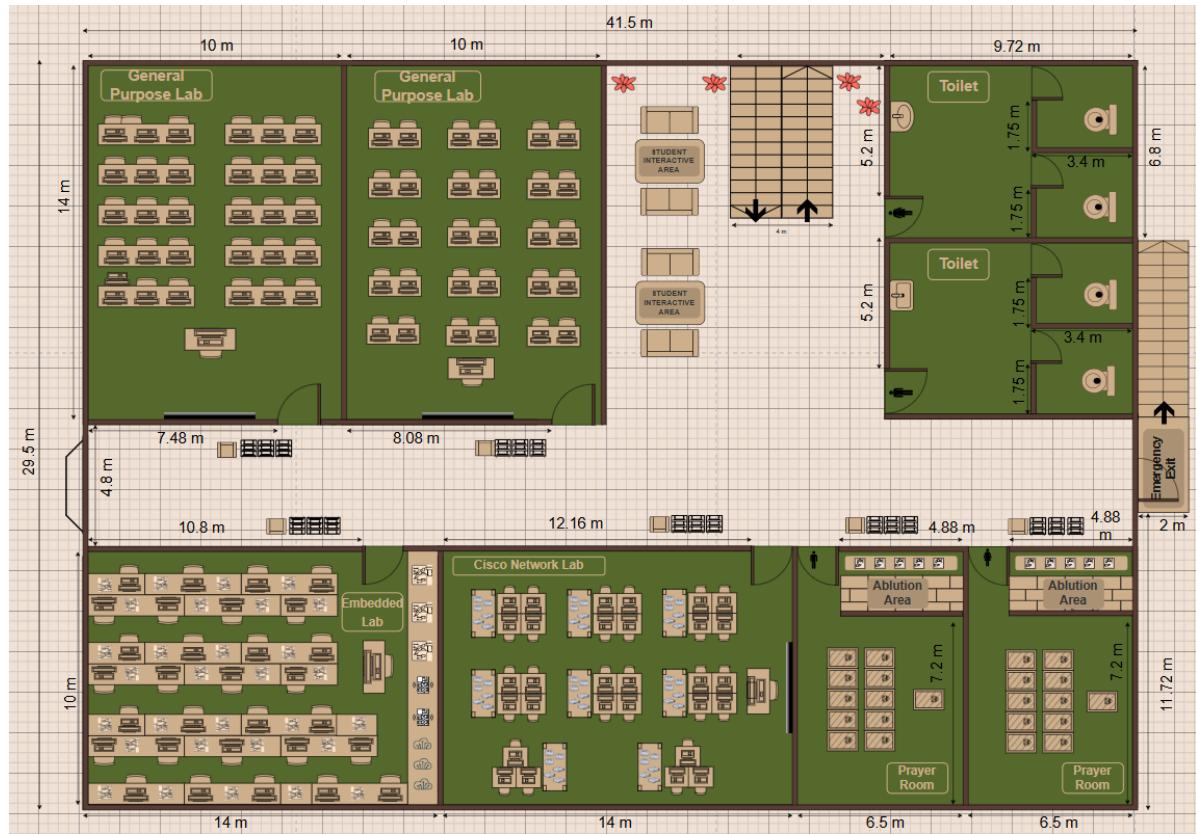
3.1.1.1 GROUND FLOOR



Figure 3.1.1.1 shows the floorplan of the ground floor of the new building

The ground floor of the new building consists of a hybrid classroom, pantry, student's lounge, staff's room and video conferencing room. The staff's room consists of 40 workstations to handle the upcoming staff. The pantry is built to accommodate the students' needs. Student's lounge is built for the students to relax while waiting for the next class.

3.1.1.2 FIRST FLOOR

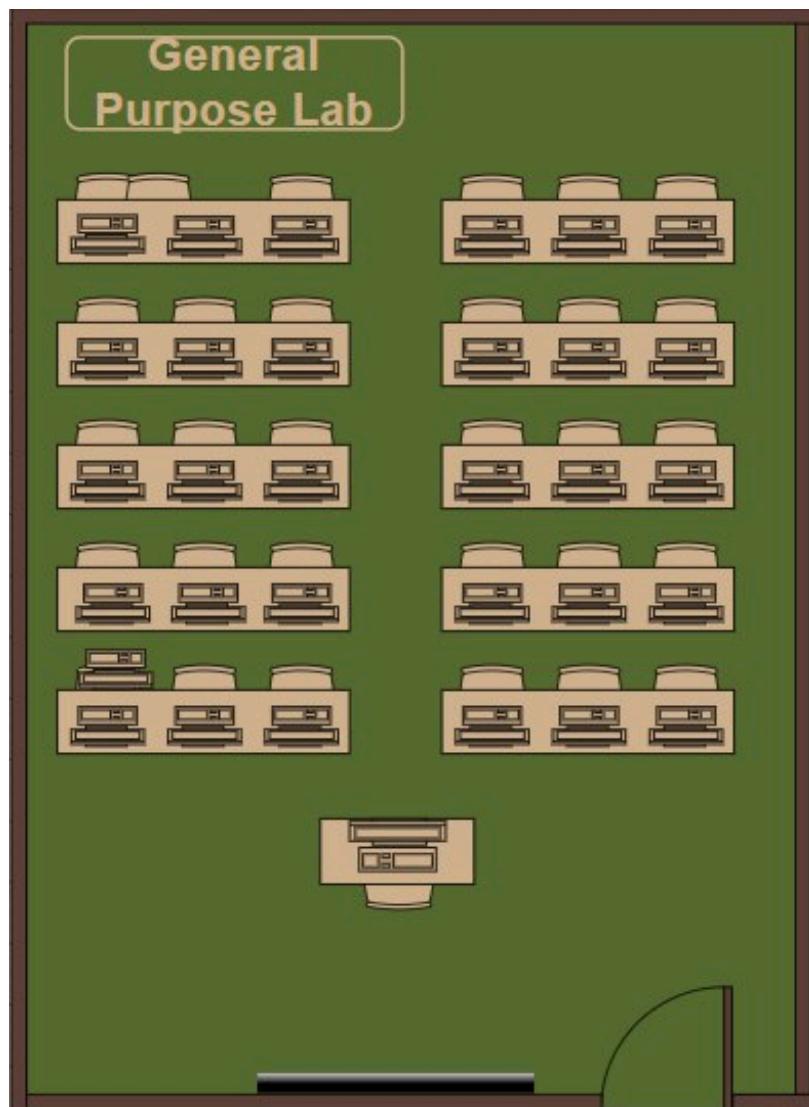


1 cm: 3 m

Figure 3.1.1.2 shows the floorplan of the first floor of the new building

This building is 29.5 m in width and 41.5 m in length. The first floor of this building consists of 2 general purpose labs, 1 Cisco Network lab and 1 Embedded lab for teaching purposes, a server room to place the server for handling the operation of the network for the building and 2 prayer rooms to accommodate Muslim students for their prayers.

3.1.1.3 GENERAL PURPOSE LABS

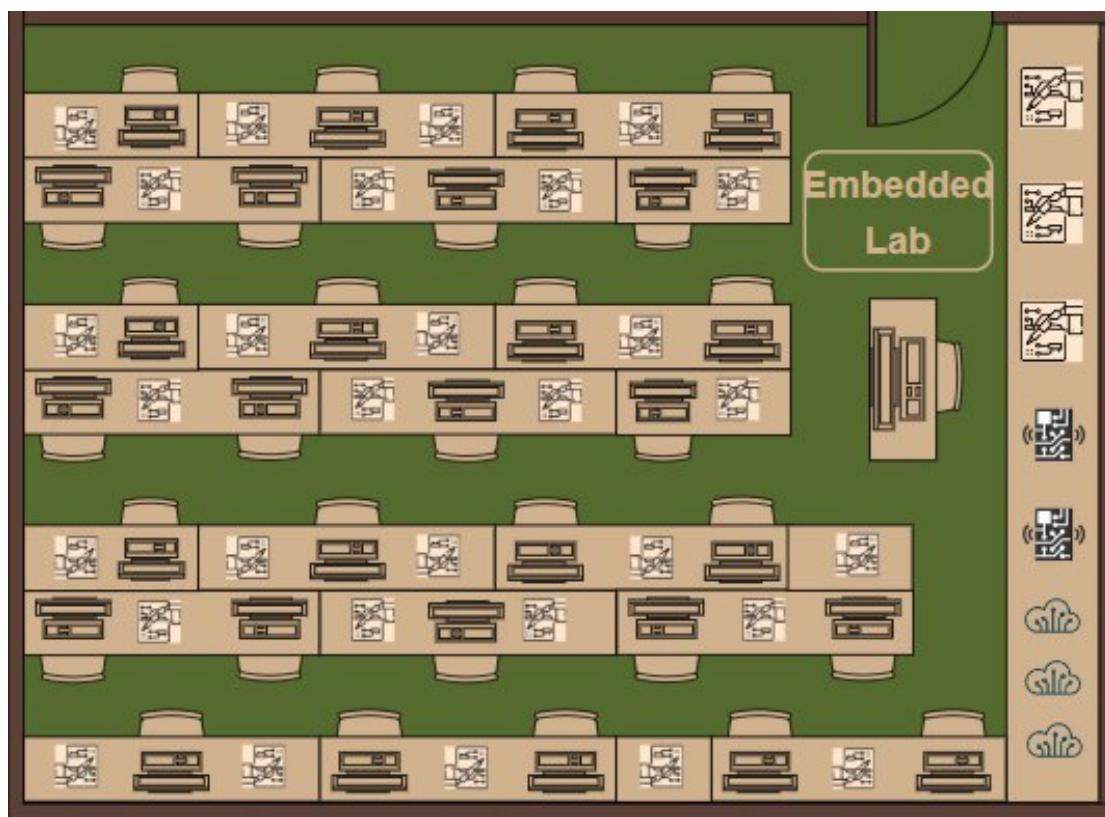


1 cm : 1 m

Figure 3.1.1.3 shows the floorplan of the general-purpose labs

On the first floor, there are 2 general labs. This lab is 14m long and 10m wide. For the general labs, it will fit 30 users (30 workstations) for students and 1 workstation for lecturers with 1 projector connected to it and the student's computers connected with each other.

3.1.1.4 EMBEDDED LAB

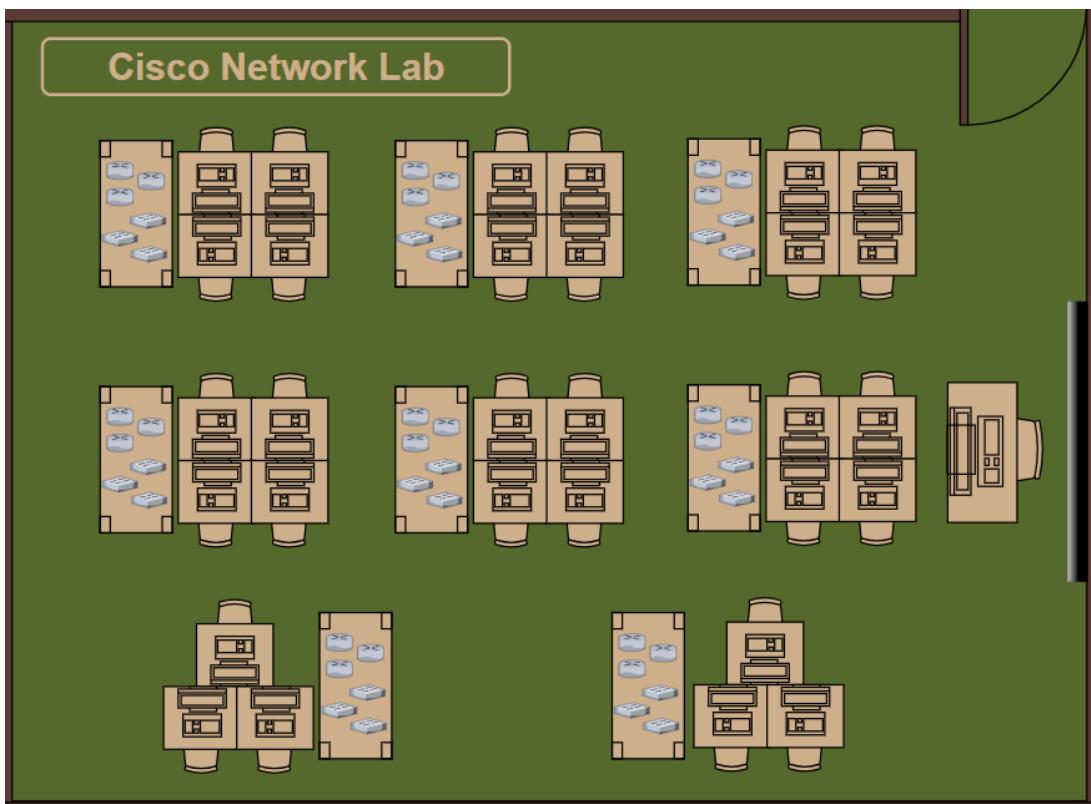


1 cm : 1 m

Figure 3.1.1.4 shows the floorplan of Embedded Lab

The embedded lab which is also found on the second floor will also have 30 workstations for the students and 1 workstation for the lecturer which is connected to a projector. This lab is also designed to implement devices and peripherals that can facilitate learning. The size is 14x10m.

3.1.1.5 CISCO NETWORK LAB

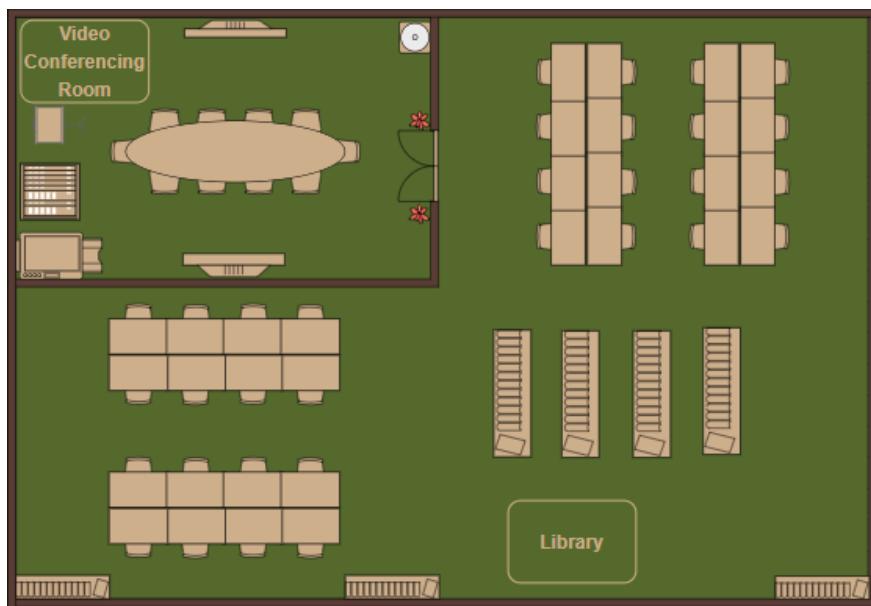


1 cm : 1 m

Figure 3.1.1.5 shows the floorplan of Cisco Network Lab

On the second floor, the Cisco Network lab will have 30 workstations for the students and 1 workstation for the lecturer which is connected to a projector. The lab will be designed to accommodate the use of network devices. It is 14 x10m. Each rack at the side of student workstations contains 3 routers and 3 switches.

3.1.1.6 LIBRARY AND VIDEO CONFERENCING ROOM

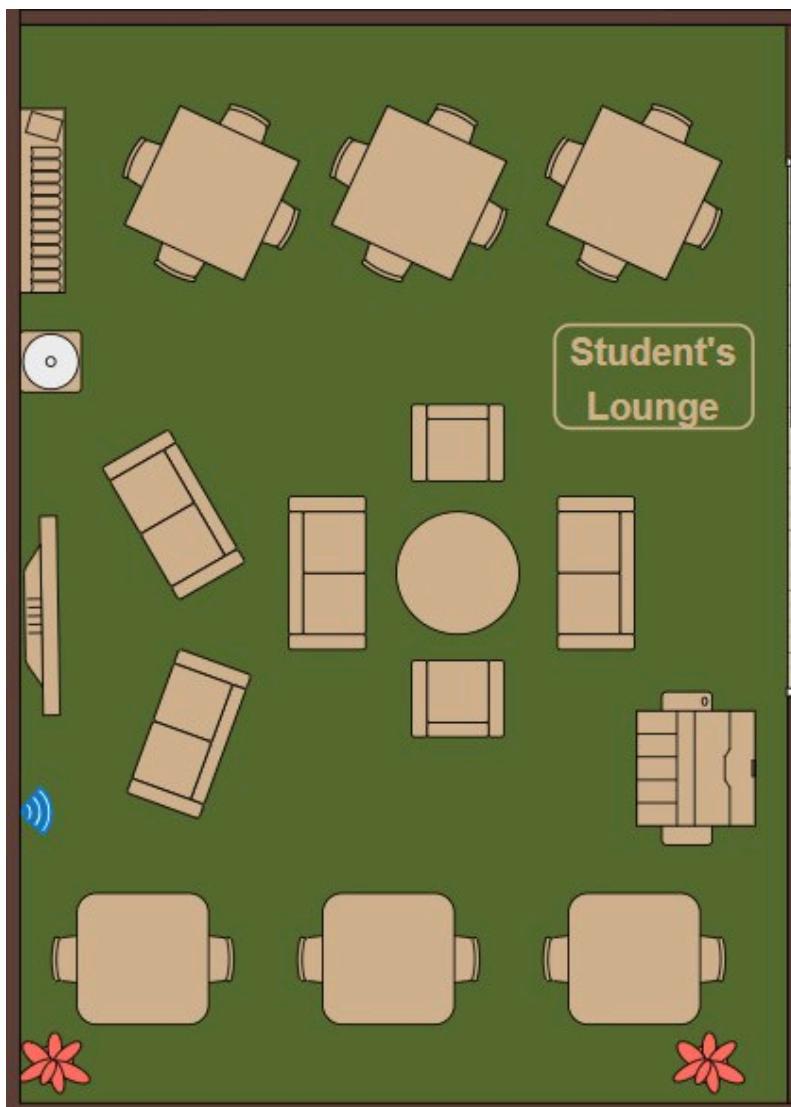


1 cm : 1.5 m

Figure 3.1.1.6 shows the floorplan of Library and Video Conferencing Room

It has a video conferencing room meant for meetings, equipped with a high-quality webcam, a copier machine beside the conference room, and a water dispenser on the right side of the entry. Throughout the library, you'll find additional tables and chairs arranged for collaborative work, providing ample workspace for users. Lounge chairs are strategically placed for relaxation or casual reading. The bookshelves line the walls, offering a wide range of reading materials and research tools.

3.1.1.7 STUDENT'S LOUNGE

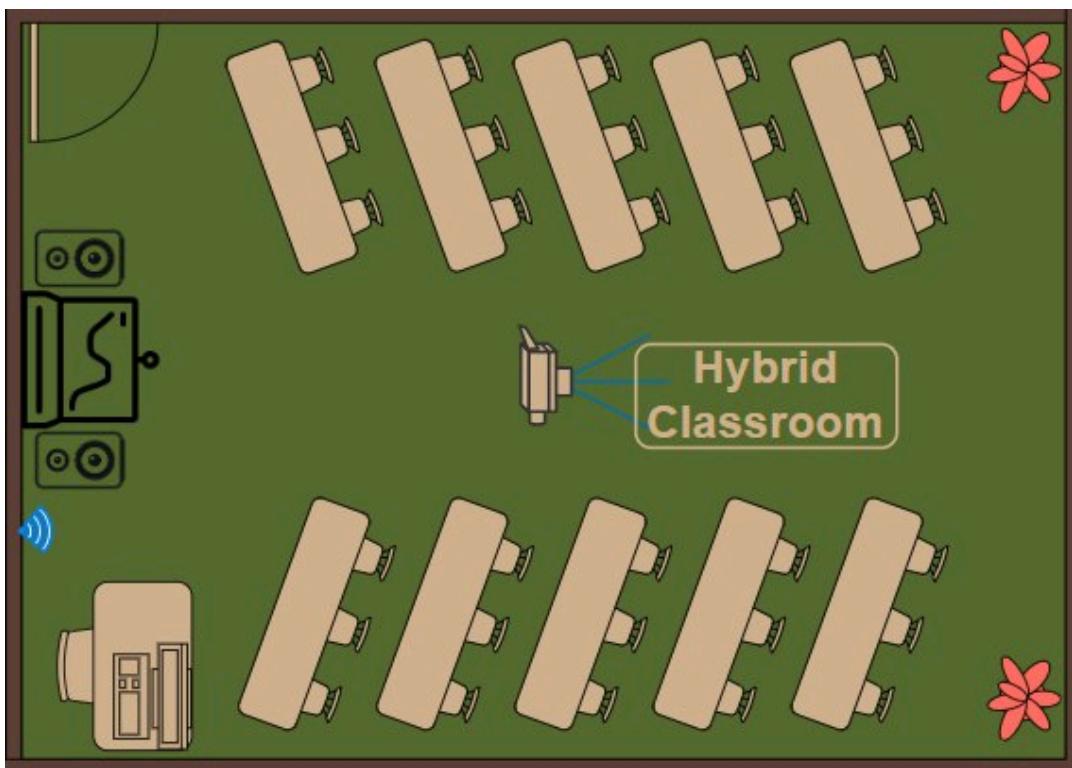


1 cm : 10 m

Figure 3.1.1.7 shows the floorplan of Student's Lounge

The student lounge is located below, in front of another facility on the same floor. The lounge has a television opposite two sofas, as well as three tables for four and three tables for two. A printer is positioned on the left side of the entrance. A round table in the centre of the lounge is surrounded by many chaise lounges and armchairs, giving students a comfortable spot to rest and mingle while they wait for their next session. In addition, there is a stand-up desk and sofa in the centre of the lounge for students to relax. Students can also replenish their water bottles using the nearby water dispenser, keeping them hydrated while connected to the internet. The size of the student's lounge is the same with the lab, 14m X 10m.

3.1.1.8 HYBRID CLASSROOM



1 cm : 1 m

Figure 3.1.1.8 shows the floorplan of Hybrid Classroom

The hybrid classroom is located on the ground level, behind the pantry, and is 9.8 meters wide and 7.54 meters long. It can comfortably accommodate up to 30 students arranged in rows of three pairs, with one workstation for the lecturer. A banner projector is located on the other side of the student tables, accompanied by two mounted speakers to ensure clear audios for the students in the classroom. A video recording camera is centrally situated, supporting virtual classrooms, and the classroom is equipped with Wi-Fi, allowing pupils to have seamless internet connectivity throughout lessons.

3.2 TASK 2

3.2.1 QUESTION AND ANSWER

3.2.1.1 QUESTION 1

What is the recommended internet speed for each of the following areas: video conferencing room, staff's room, student lounge, hybrid classroom, embedded lab, general-purpose lab, and Cisco network lab?

ANSWER :

To ensure smooth operation of networked rooms for video conferencing, labs, and staff areas, here are the recommended internet speeds based on room types:

Video Conferencing Rooms: For HD video calls, allocate around 2.5-3.0 Mbps for both download and upload per participant. Cisco Webex, Zoom, and Microsoft Teams all function well within this range, though group calls may benefit from 3.5 Mbps to ensure high stability for multiple users.

Staff and Student Lounges: Moderate usage areas like lounges, where users primarily browse, email, or do light video streaming, should have about 5-10 Mbps per user. For video streaming, allocate at least 5-8 Mbps for a better quality, which should cover most of the casual use .

Hybrid Classrooms: For hybrid environments we aim for at least 25 Mbps per room to support high quality video, screen sharing, live-streamed lectures or video calls without interruption, particularly if multiple users are connected.

Embedded and General-Purpose Labs: These labs may require 5-10 Mbps per device, particularly for students working with internet-based resources, coding platforms, or moderate streaming. This speed is sufficient for general educational tasks.

Cisco Network Labs: Cisco labs involve network training and simulations, a stable connection of 10-20 Mbps per workstation is recommended. Labs with high network traffic might also need Quality of Service (QoS) settings on routers to prioritise lab traffic and ensure consistent speeds.

Broadband Speed Guide. (2022, July 18). Federal Communications Commission.

<https://www.fcc.gov/consumers/guides/broadband-speed-guide>

3.2.1.2 QUESTION 2

What type of network structure and wiring should be used to guarantee dependable and fast connection connectivity in the labs, hybrid classrooms, and video conferencing rooms?

ANSWER:

To guarantee dependable and fast connection throughout different areas like labs, hybrid classrooms, and video conferencing rooms, a combination of structured cabling and wireless networking could be effective.

Cabling Type: It is advisable to use Category 6A (Cat6A) Ethernet cables or fiber-optic cables for backbone connections. Cat6A can achieve speeds of 10 Gbps over greater distances than regular Cat6, making it ideal for high-demand spaces such as labs and video conferencing rooms. For the router to the switch, we will use fibre optic cable because of the high bandwidth capacity, fast transmission speed, longer transmission distances and low signal interference.

Wireless Access Points (APs): Deploy Wi-Fi 6 (802.11ax) access points all over the building to accommodate more users and offer quicker speeds. Wi-Fi 6 technology is more efficient at managing numerous connections in high-traffic locations like the Student's Lounge.

Switching and Routing Equipment: Managed switches with Power over Ethernet (PoE) capability offer advantages in labs and classrooms. This is able to supply power to devices like IP phones, access points, and other connected devices without the need for separate power sources.

Video Conferencing Requirements: The Video Conferencing Room should have high-definition (HD) cameras, microphones, and dedicated video conferencing equipment, which can benefit from a direct fiber or Cat6A connection to reduce the latency and packet loss.

Jones, A., Sevcik, P., & Wetzel, R. (2021). *Internet connection requirements for effective video conferencing to support work from home and eLearning* (NFR5137). NetForecast.

https://www.netforecast.com/wp-content/uploads/NFR5137-Videoconferencing_Internet_Requirements.pdf

Standards frequently asked questions. (n.d.). Default.

<https://www.bicsi.org/standards/bicsi-standards/resources/standards-frequently-asked-questions>

3.2.1.3 QUESTION 3

What are the good standard hardware specifications that you wish to employ for each PC in every lab and a hybrid classroom?

ANSWER:

An excellent or recommended computer specs allow programming chores to operate smoothly and avoid the hardware issues. This boost a programmer's productivity and directly affects how effectively they work.

Operating System: Windows Operating System is compatible with a large number of hardware and software. In terms of performance in windows 11 is intended to function smoothly and quickly, with better memory management and resource allocation.

Processor (CPU): The use of processor i5 or AMD Ryzen 5 allows for multitasking and supports virtualization technologies. It can run different development tools that are commonly used by programmers.

RAM(random access memory): A minimum 8GB RAM is required and 16GB RAM is recommended. Quick read and write capabilities are critical for efficiently running applications and accomplishing tasks, especially when dealing with the demanding software such as programming environments, games or design tools.

Graphic Card: For better performance, NVIDIA GeForce GTX 1660 or AMD Radeon RX 5600 XT both are mid-range cards that perform in more demanding applications such as game creation, most programming software like visual studio code, dev c++ and others. They can also effectively manage several displays which is useful for multitasking.

Display (screen): The screen that fits for programmers are basically from size 22-24 inch. The size strikes a mix between having enough screen for multitasking and sitting comfortably at most. The best resolution is 1080p (1920 X 1080, which provides clear text and a big workplace without straining the eyes.

Jsonmez. (2023, January 12). *5 CRUCIAL PC hardware components programmers NEED to upgrade.*

Simple Programmer. <https://simpleprogrammer.com/best-coding-hardware/>

3.2.1.4 QUESTION 4

What are the software preferences and needs for labs and a hybrid classroom?

ANSWER:

- 1) General Purpose Lab:
 - a) Visual Studio Code, Python, Linux environment and Dev C++: To write the coding based on the tasks given in the lab.
 - b) MySQL for database management systems: To code the database or queries the data.
 - c) GitHub for sharing the code.
 - d) Microsoft 365 (Word, Excel and Powerpoint): Is used to create a document and report, create a ledger to calculate anything and slide presentation.
 - e) Google Chrome: For web search purpose.

- 2) Cisco Network Lab
 - a) Cisco Packet Tracer: A network simulation tool, to design network topologies and simulate network activity.
 - b) Cisco Webex: Collaborative tool, it is used for meeting purposes.
 - c) Cisco Prime Infrastructure: Network management tool that allows you to configure and monitor wired and wireless networks.
 - d) Cisco DNA Center: For analysis, a centralised management platform for Cisco's intent-based networking solutions with emphasis on automation, assurance and analytics.

3) Embedded Lab

- a) Arduino IDE: An electronic platform that allows users to write, compile, build and upload the code to an Arduino board.
- b) Atmel Studio: For developing applications for Atmel's(Microchip Technology) microcontrollers and microprocessors. It offers a wide range of tools for coding, debugging and programming embedded devices.
- c) Node-RED: An open source flow based programming tool that connects physical devices, API and web services visually.
- d) ThingsBoard: An open source IOT platform intended for data collecting, processing, visualisation and device management

4) Hybrid Classroom

- a) Microsoft 365 (Word, Excel and Powerpoint): Is used to create a document and report, create a ledger to calculate anything and slide presentation.
- b) Google classroom: Online learning platform.
- c) Microsoft Teams: Collaboration platform that uses chat, video conferencing, communication within enterprises.
- d) Zoom: The video conferencing platform that allows users to host and participate in virtual meetings and webinars.
- e) Microsoft Whiteboard: A digital collaboration platform that allows you to brainstorm, plan and visualise ideas in real-time.
- f) Google Meet: Is a video conferencing software that allows users to arrange and attend virtual meetings, webinars and video conferences.
- g) Cisco Webex: Collaborative tool, it is used for meeting purposes.
- h) Google Chrome: For web search purpose.

3.2.1.5 QUESTION 5

Why choose Wi-Fi 6 over other routers for the installation in the faculty building?

ANSWER:

Wi-Fi 6

The Wi-Fi 6 delivers considerable benefits that are specifically geared to the needs of educational contexts, where several devices are frequently connected concurrently. One of the fundamental advantages of Wi-Fi 6 is its capacity to support high density of devices while maintaining performance. Wi-Fi 6's capabilities, such as Orthogonal Frequency Division numerous Access(OFDMA). Let numerous devices communicate simultaneously on a single channel, lowering latency and assuring smoother connections during peak usage times, such as online classes. This capacity is especially useful in faculty buildings, where multiple computers, smartphones and IOT devices may be in use at the same time.

Additionally, Wi-Fi 6 also provides faster, longer-range and more efficient performance than earlier standards. It contains Multi-user, several input, Multiple Output(MU-MIMO) technology, allowing the router to communicate with several devices at the same time, which is critical in classroom and administrative offices where multiple users are accessing data simultaneously. TP-Link

(n.d.). *TP-Link*. <https://www.tp-link.com/my/wifi6/>

3.2.1.6 QUESTION 6

What kind of antivirus software would be installed on each PC in the lab and classroom?

ANSWER:

For the lab and classroom we are choosing to use BitDefender Antivirus Software for PCs in the lab and classroom. It provides powerful malware detection capabilities, which use complex algorithms and machine learning to identify and stop threats in real time. This protects both lectures and students against a variety of security dangers including viruses, ransomware and phishing attacks, resulting in a secure online learning environment.

These BitDefender Edition below shows a features for both edition:

BitDefender Antivirus software (Free Edition)

Real-Time Protection: Provides continuous monitoring to detect and mitigate hazards as they arise.

Malware Scanning: Performs quick thorough scan for viruses, malware and other security threats..

Behavioural Detection: Monitors running programs for suspicious activity and automatically prevents hazardous behaviours.

Anti-Phishing Protection: Protects sensitive information by alerting users to probable phishing attacks.

BitDefender Antivirus software (Paid Edition)

Advanced Threat Defense: Uses machine learning methods to detect and prevent new and unexpected threats.

Multi-Layer Ransomware Protection: Adds an extra layer of defence against ransomware assaults, assuring data safety .

VPN(Virtual Private Network): Provides a secure VPN for anonymous browsing and protection over public Wi-Fi .

Password Manager: Helps save and manage passwords securely, improving overall security.

Parental Control: Allows monitoring and management of online activities, resulting in a safer browsing experience for students.Yee, A. (2024, August 7). *Bitdefender Total Security review: Great, easy to use protection.* PCWorld.

<https://www.pcworld.com/article/393363/bitdefender-total-security-review.html>

3.2.1.7 QUESTION 7

Which primary topology should be presented for the utilisation of the facility building?

ANSWER:

The main network topology that should be applied in this project will be star topology. Star topology will require each device to be connected to a central switch. This allows for easier addition or removal of connected devices without having to shut down the entire network and easier monitoring and management. Other than that the advantage of using star topology is that it is easy to troubleshoot. Each host is connected to the central device with its own wire. If there is a problem with that cable, only that host is affected while the rest of the network remains operational. Dolezal, L. (n.d.). *IT essentials: Network topologies*. SharpSchool. Retrieved October 31, 2024, from

https://cdnsm5-ss6.sharschool.com/UserFiles/Servers/Server_20856499/File/Teacher%20Pages/Lind%20say%20Dolezal/IT%20Essentials/6.5.pdf

Petrek, J., & Sledt, V. (2001). A large hierarchical network star—star topology design algorithm.

European Transactions on Telecommunications, 12(6), 511–522.

<https://doi.org/10.1002/ett.4460120607>

Khan, S., Jackson, G., & Goodwin. <https://www.ibm.com/topics/network-topology>

3.2.1.8 QUESTION 8

Should access to any specific sites be restricted to any specific users, other than what is prohibited by the government?

ANSWER :

Yes, gaming websites such as Steam and Valorant should be blocked, to prevent misuse by the students. Artificial Intelligence sites should also be blocked, to prevent the students' overreliance on these tools to solve their problems, instead of developing their own critical thinking skills and knowledge. This is also done for security reasons, as to prevent the users from accidentally accessing potentially harmful and malicious malware, affecting the integrity of the network.

3.2.1.9 QUESTION 9

How do you ensure that this network can be accessed exclusively by UTM-affiliated personnel, specifically its staff and students?

ANSWER :

Both students and staff will be given an ID during their registration. This ID is required for them to access the network. To prevent online personification, a strong password that is set up during registration is also required for them to gain access to the network. By doing this, we can prevent this network from being accessed by unauthorised personnel.

3.2.1.10 QUESTION 10

Is it better to let the whole speed be allowed for every device or is it better to put a speed limit for each device that connects to the network ?

ANSWER :

It is better to limit the speed per device for the devices connected to the network. A place like the faculty of computing will have many students connecting their phones and laptops.

Putting a speed limit will have benefits as follows:

- 1- Priority traffic: It allows the administrator to control which applications or rooms get the higher bandwidth. Because some places like video conference rooms need higher speed compared to other areas like lounges or teaching classes.
- 2- Fair usage: It ensures fair usage for everyone. That means that no student or a guest gets to monopolise the whole bandwidth if it is not limited per device. This ensures that everyone connected gets to use their bandwidth freely without facing the problem of bad or slow connection.

3.2.1.11 QUESTION 11

How authorization to connect to the network is done? Is it software or something within the hardware equipment ?

ANSWER:

It is a mix of both software and hardware. This means that it is done using software but the router must also be compatible to do it. It is called Captive Portal. It allows the owner to control the networks the user will connect to depending on his standing. Either a guest, a staff, or an admin. I also need a form of database to authenticate which is which.

Enable a Captive Portal on your Cisco Wireless Network. (2024, May 1). Cisco.

<https://www.cisco.com/c/en/us/support/docs/smb/wireless/cisco-small-business-300-series-wireless-access-points/smb4937-enable-a-captive-portal-on-your-cisco-wireless-network.html>

3.2.1.12 QUESTION 12

Will PCs in Labs Require cable or wifi and why ?

ANSWER:

It is preferred to have a wired Internet in PC labs because although wireless is convenient, wired connection is more stable and consistent. It is also more secure. It is also more cost effective as it provides these advantages with cheaper cost compared to wireless connection.

Nambiar, R. (n.d.). Wired vs Wireless Internet: Evaluating Pros and Cons. *TATA Play Fiber*.

<https://www.tataplayfiber.com/blog/wired-vs-wireless-internet-evaluating-pros-and-cons>

3.2.2 FEASIBILITY STUDY

This feasibility study highlights the essential components of the network infrastructure and technology implementation for the UTM faculty building, which are intended to meet the connection, security, and functionality requirements of lecturers, students, and staff. The configuration includes labs, classrooms, hybrid classrooms, video conferencing rooms, staff rooms, and student lounges, resulting in a dependable, high-performance network environment.

To offer a scalable and efficient network, a star topology will be used, with all devices connected to a central switch or router, simplifying network management and maintenance. Cat 6a Ethernet cables will be utilized for wired connections in important places like labs and classrooms to enable high-speed data transfer. In addition, Wi-Fi 6 access points will be installed in common spaces such as student lounges and staff rooms to accommodate the increasing number of devices. Fiber-optic cables will be used in bandwidth-intensive locations like the Cisco network lab and embedded labs to enable quick and dependable connections for simulation and network configuration operations.

To ensure peak performance, lab and hybrid classroom PCs will be outfitted with Intel i5 or AMD Ryzen 5 processors, 8-16 GB of RAM, and 256 GB of SSD storage. These hardware specifications will enable the essential instructional applications, including MATLAB, Cisco Packet Tracer, and Microsoft Office and Zoom. By providing the necessary hardware resources, the setup will cater to the different needs of students and instructors in technical and general-purpose laboratories.

The network will use a multi-layered security strategy, beginning with BitDefender Antivirus Software on all PCs in labs and classrooms. BitDefender detects and prevents threats including viruses, ransomware, and phishing assaults by leveraging machine learning and powerful algorithms. Furthermore, Captive Portal authentication will restrict network access based on the user's role (guest, staff, or administrator). The Captive Portal solution consists of both software and hardware components: a suitable router and a database for user authentication. Network Access Control (NAC) and 802.1X authentication will be used to ensure that only authorized users can connect to the network, while WPA3 encryption will protect both wired and wireless connections.

For a variety of reasons, wired connections are preferable than wifi in the lab. Although Wi-Fi is convenient, wired connections provide greater stability and consistency for high-bandwidth activities commonly performed in laboratories, such as simulations and research. Wired connections are also safer and more cost-effective than wireless connections, as they eliminate the possible security threats connected with Wi-Fi while providing higher performance at a cheaper overall cost.

To guarantee that all regions of the facility have adequate bandwidth, internet speeds will be assigned based on usage. Video conferencing rooms and hybrid classrooms will be assigned 100-200 Mbps, while laboratories with higher demands, such as the embedded and Cisco network labs, would be granted 500 Mbps to 1 Gbps to enable resource-intensive applications. Quality of Service (QoS) protocols will be used to regulate traffic and reduce network congestion, ensuring that bandwidth is evenly distributed across the facility.

The planned network architecture for UTM's faculty building offers a stable, high-performance, and secure environment for all users. By integrating Wi-Fi 6, wired connectivity, BitDefender antivirus, and Captive Portal authentication, the network will provide instructors, students, and staff with secure and dependable access. The use of innovative gear and software will benefit both technical labs and hybrid classrooms, ensuring that all educational demands are satisfied quickly. This complete design will enable UTM to create a modern and scalable network that can accommodate both current and future technological breakthroughs.

3.2.2.1 TECHNICAL FEASIBILITY STUDY

The proposed network architecture for the UTM Faculty Building is theoretically possible, with a well-designed star topology connecting all devices to a central switch or router for easy control and scalability. Cat 6A Ethernet cables will be installed in high-traffic locations like labs and classrooms to provide high-speed, dependable connections, while Wi-Fi 6 access points will be put in common spaces like student lounges and staff rooms to accommodate an increasing number of devices. Fiber-optic cables will be employed in bandwidth-intensive labs, such as the Cisco network and embedded labs, to provide rapid and reliable data transmission. The gear arrangement includes PCs with Intel i5 or AMD Ryzen 5 processors, 8-16 GB RAM, and 256 GB SSD storage to run instructional applications such as MATLAB, Cisco Packet Tracer, and Zoom. A multi-layered security strategy, including BitDefender Antivirus, Captive Portal authentication, NAC, and WPA3 encryption, will shield the network from external threats, while internet bandwidth allocation and QoS standards will assure peak performance throughout the facility.

3.2.2.2 OPERATIONAL FEASIBILITY STUDY

The suggested network design has high operational feasibility since it ensures simplicity of management via the star topology, which facilitates troubleshooting and extension. Wi-Fi 6 with Cat 6A cabling provides flexibility and scalability, allowing for the easy addition of new devices or locations without any disturbances. The usage of modular patch panels enables easy updates, lowering future infrastructure expenditures. The architecture is cost-effective in the long run since wired connections provide more reliable performance for high-demand activities, eliminating the need for large Wi-Fi infrastructure. Wi-Fi 6 access points will handle an increase in device numbers efficiently, while security features such as BitDefender Antivirus, Captive Portal, and NAC provide protection and limit the danger of costly breaches. Overall, the proposed network is intended to be scalable, secure, and cost-effective, providing a firm foundation for UTM's operating demands and ensuring long-term viability.

3.2.2.3 ECONOMIC FEASIBILITY STUDY

Estimated Cost		Comment
Development	RM	-
Hardware	60000	-
		-
Production	RM	-
Implementation	50000	Per year
Server Hosting	20000	Per year

Table 2.3.1: Estimated Cost

Estimated Benefits		Comment
	RM	-
Savings	20000	Per year
Improved efficiency	15000	Per Year
Enhanced user experience	10000	Per year

Table 2.3.2: Estimated Benefits

Assumption	
Discount rate	5%
Sensitivity factor (Cost)	0.1
Sensitivity factor (Benefits)	0.2
Annual change in production costs	0.03
Annual change in benefits	0.02

Table 2.3.3: Assumptions For 4 Years Project Duration

3.3 TASK 3

3.3.1 LIST OF DEVICES

3.3.1.1 ROUTER

Product	Cisco ASR 1001-X	Juniper MX204-HW-BASE	Mikrotik CCR1072-1G-8S-plus-
Ports	Modular	8 x 100G QSFP28, 8 x 10G SFP+	1x Gigabit Ethernet, 8x SFP+ Cages
Throughput	Up to 20 Gbps	Up to 400 Gbps	80Gbps
Memory	8 GB DRAM, 8 GB Flash	1 GB RAM, 512 MB Flash	1GB NAND 128MB Flash
Power Consumption	~250 Watts	~350 Watts	~125W
Warranty	1 year (extendable with support contracts)	1 year	3 years reseller warranty
Price	RM83,283.51	RM27,629.16	RM13,221.38
Reference	https://www.router-switch.com/asr1001-x-p-5682.html	https://www.router-switch.com/mx204-hw-base.html#tab-specification	https://www.router-switch.com/mikrotik-ccr1072-1g-8s-plus.html



Figure 3.3.1.1 shows the Juniper MX204-HW-BASE routers

A router is a networking device that forwards packets of data between computer networks from the source of a data packet to its destination. In this task ,the router should have enough throughput and computing power to handle 100+ concurrent users, divided between each workstation in every lab, a hybrid classroom, a video conferencing room, and the other user connected to the network wirelessly in the student's lounge and other parts of the building such as the toilets, the student interactive area, the library and the corridors.

For our router, we decided on the **Juniper MX204-HW-BASE**. It has the highest throughout out of these 3 routers, ensuring a smooth and uninterrupted internet experience for the users. It also has 8 fibre ports that can be taken advantage of in the future in the case the client chooses to make further upgrades on the network connection.

3.3.1.2 SWITCH

Product	Ruijie Networks Rg-Nbs3100-48Gt4Sfp-P switch	Cisco Catalyst 2960-X switch 24 ports	TP-LINK TL-SG2428P JetStream 24-Port 10/100Mbps + 4-Port Gigabit Smart Switch with 24-Port PoE+
Ports	48 x Gigabit Ethernet, 4 x SFP uplink ports	24 x Gigabit Ethernet, 4 x SFP uplink ports	24 x Gigabit Ethernet, 4 x SFP uplink ports
PoE Support	Yes, PoE+ supported	Yes, PoE+ supported	Yes, PoE+ supported
Switching Capacity	104 Gbps	216 Gbps	56 Gbps
Forwarding Rate	77.37 Mpps	108 Mpps	41.7 Mpps
Layer Support	Layer 2+	Layer 3	Layer 2+
Warranty	5 years	Limited Lifetime Warranty	3 years
Price	RM5,597.99	RM5,879.99	RM1,270.99
Reference	https://shopee.com.my/product/27503136/21587477544?gads_tsig=VTJGc2RHVmtYMTlxTFVSVVRRdENkWVp3RFo3Mkw5czd4Z0hzdEF1WVFiblh0RTdoK0hEMWRGdVZ4M1kwVGMrdHROcllIukN0RDBCMDZ2OUtMcj14Q01YUEpZRVZrN3N0VIVuMHJBYkN5SDIFKzU2S1hrOXVBUmMxWWpDSnZ3SmI	https://www.tradeinn.com/techinn/en/cisco-catalyst-2960-x-switch-24-ports/137972795/p?queryID=0c86d96f6003f5e3fbabf505dc89175&buscador_search	https://2shop.com.my/product/tp-link-tl-sg248p-jetstream-28-port-gigabit-smart-switch-with-24-port-poe/



Figure 3.3.1.2 shows the Ruijie Networks Rg-Nbs3100-48Gt4Sfp-P switch

Meanwhile, a network switch is a device that connects end devices to a computer network by using packet switching to forward and receive packets of data to its destination. A network switch chosen must have enough forwarding rate to support 120+ workstations at the same time and around 15 access points to ensure the users have spotless and uninterrupted internet connection. This is a must to provide a smooth and conducive learning experience. A layer 2 switch should suffice as we decided to buy a separate router to perform the routing tasks. The switch should also support Power-over-Ethernet feature as per client's request.

Thus, **Ruijie Networks Rg-Nbs3100-48Gt4Sfp-P switch** is chosen as it checks all the boxes of being able to handle all the potential users of the new network simultaneously while costing only half the price. Due to the exhaustive number of ports, the number of access switches that need to be bought is half compared to the Cisco model while costing around the same amount for each switch. The Ruijie switch also comes with a 5 year warranty, ensuring the client's calmness and security in the future regarding the longevity and durability of these products. The TP-Link model, while costing cheaper, would cost the university more in the long run as buying more switches would end up increasing the operational costs of the networks, especially regarding the electricity bill. Plus, the amount of space and cabling required to operate 8 different switches is much more complicated compared to only 4 switches. Plus, the switching capacity and forwarding rate of the TP-Link switches is abysmal compared to the Ruijie one.

3.3.1.3 ACCESS POINT

Product	HPE Aruba Instant On AP25 (RW) 4x4 Wi-Fi 6 Access Point	Ubiquiti UniFi U6-Enterprise-Wifi-6 WIFI Access Point	Ruijie RG-RAP2260(G) Reyee Wi-Fi 6 AX1800 Ceiling Access Point
Wi-Fi Standard	Wi-Fi 6 (802.11ax)	Wi-Fi 6E (802.11ax)	Wi-Fi 6 (802.11ax)
Frequency Bands	Dual-band: 2.4 GHz and 5 GHz	Tri-band: 2.4 GHz, 5 GHz, and 6 GHz	Dual-band: 2.4 GHz and 5 GHz
Maximum Data Rate	Up to 5.3 Gbps (aggregate)	Up to 4.8 Gbps	Up to 1.775 Gbps
Maximum Clients	100+	Up to 600 clients	180 clients
Security Features	WPA3, Enhanced Open, WPA2,	WPA3, WPA2, WPA	WPA3, WPA2, WPA
Warranty	2-year warranty	1-year warranty	3-year warranty
Price	RM1,157.00	RM1,432.49	RM796.00
Reference	https://www.networkhardware.com/en-my/products/instant-on-a-p25-indoor-access-points-r9b27a?variant=41061034328269	https://www.tradeinn.com/techinn/en/ubiquiti-unifi-u6-enterprise-wifi-6-wifi-access-point/139546323/p?queryID=95d29befd90928cc38f5407dc24d2579&buscador_search	https://wme.my/products/ruijie-rg-rap2260g-reyee-wi-fi-6-ax1800-ceiling-access-point?_pos=8&_sid=594a51374&_ss=r



Figure 3.3.1.3 shows the HPE Aruba Instant On AP25 (RW) 4x4 Wi-Fi 6 Access Point

An access point is a device that allows end devices to connect to the network through Wi-Fi (wirelessly). Access points should support Wi-Fi 6 standard to provide an internet connection with utmost stability. A 5GHz channel should also be included as the users mainly own devices that can take advantage of the channel's high bandwidth and low latency. It must also support a minimum of WPA3 security programs to protect the connection from being breached or utilized by unauthorized and irresponsible parties. The maximum data rate should also be high to support all concurrent users accessing the network at the same time. Additionally, to provide an uninterrupted connection seamless handoff between access points is a compulsory feature to have. The group of access points also should be able to blanket the new building with high-speed wireless internet connection.

The **HPE Aruba Instant On AP25 (RW) 4x4 Wi-Fi 6 Access Point** became our top choice as it provides the highest throughput among all other access points. It also comes with a 2 year warranty. The low number of clients supported should not matter as we intend to set up high number of access points throughout the building, ensuring the users to receive high-speed internet connection anywhere in that building

3.3.1.4 PATCH PANEL

Product	Legrand Cat 6A Patch Panel	Tripp Lite Cat 6A Patch Panel
Category	CAT6A	CAT6A
Number Of Ports	24	24
Speed	Supports 10 Gbps speeds	Supports 10 Gbps speeds
Performance	Future-proof for demanding applications and growth	Reliable performance in standard networking setups
Quality	High quality construction built for long-term use	Reliable for most standard setups
Installation	<ul style="list-style-type: none"> - Easy to install with tool less punch-down system - Includes integrated cable management for neatness - Clear labelling makes identification easy 	<ul style="list-style-type: none"> - Simple design, easy to install - Comes with strain relief brackets - Quick setup for budget-conscious institutions
Disadvantages	Advanced features might not be needed for all setups	Basic cable management (no advanced features)
Flexibility	Scalable for future proofing large networks	Best for budget-conscious and smaller setups
Price	RM 3 846.65	RM 1503,89
Reference	<p>https://nz.rs-online.com/web/p/rj-patch-panels/1789290?srsltid=AfmBOorB5ONn8v1kc0qrxA s7jghHddsL0f6nvRf6a6sYt07 dJFxZ3W6</p>	<p>https://www.connection.com/product/tripp-lite-24-port-cat6a-patch-panel-feedthrough-rackmount-rj45-ethernet-1u/n254-024-6a/30657644?srsltid=AfmBOoqU2pFKyzUB9yA_WNqfQZ-1WonWF LKzrNLknTswDH-ws1DEgrg1</p> <p>https://my.element14.com/eaton-tripp-lite/n254-024/patch-panel-rj45-cat6-6a-24port/dp/2925651?srsltid=AfmBOoqio pn-ucD5vKSErCkyiEQoxQs7DPFqQE DXZUxDAPWIocgB6J9S</p>



Figure 3.3.1.3 shows the Legrand CAT 6A patch panel

Our group decided to choose the **Legrand CAT 6A patch panel** for a growing faculty due to its ability to support 10 Gbps Ethernet speeds , making it suitable for high demand applications like video conferencing, large file transfers and real-time collaboration tools. As the faculty expands with increasing numbers of students and staff, the panel offers scalability through various port configurations, allowing for easy network expansion. Its high-performance, reliable design ensures stable and secure connections, while its capability to handle high-density environments makes it perfect for classrooms, labs and lecture halls. With features that future-proof the network, ease of installation and efficient cable management, the Legrand CAT 6A patch panel ensures the faculty's network will meet the growing connectivity and performance needs well into the future.

3.3.1.5 CABLE

3.3.1.5.1 CAT6A CABLE

Product	Lanberg U/Utp CAT6A Reel network cable 305 m	Ubiquiti UC-C6-CMP CAT6 UTP Reel	PNI UTP CAT6 PNI U06
Category	Cat6	Cat6	Cat6
Length	305 meters	305 meters	305 meters
Conductor Material	Solid Copper	Solid Copper	Copper-Clad Aluminum (CCA)
Gauge	24 AWG	23 AWG	24 AWG
Shielding Type	Unshielded Twisted Pair (UTP)	Unshielded Twisted Pair (UTP)	Unshielded Twisted Pair (UTP)
Jacket Material	PVC	Low Smoke Flame Retardant PVC	PVC
Flame Rating	Fca	NFPA 262	Not specified
Warranty	24 months	24 months if purchased from Ubiquiti Official Store	Not specified
Price	RM631.99	RM1,844.49	RM187.99
Reference	https://www.tradeinn.com/techinn/en/lanberg-u-utp-cat6a-reel-network-cable-305-m/139224979/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search	https://www.tradeinn.com/techinn/en/ubiquiti-uc-c6-cmp-cat6-utp-reel-network-cable-305-m/138698827/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search	https://www.tradeinn.com/techinn/en/pni-rj45-utp-cat6e-network-cable-305-m/138120232/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search



Figure 3.3.1.5.1 shows the Lanberg U/Utp CAT6A Reel network cable 305 m

A networking cable is a piece of hardware that is used to physically connect one network device to another network device. It should be in the category Cat6 or higher to ensure the cable chosen is capable of handling the bandwidth required by all concurrent users simultaneously. The conductor material should be made of solid copper core instead of copper-clad aluminium. While features like fire protection are nice to have for future peace of mind, it is not necessary.

Thus, we opt to choose the **Lanberg U/Utp CAT6A Reel network cable 305 m** as our cable. The cable fits all our requirements without breaking the bank. Although the Ubiquiti cable comes in 23 AWG gauge compared to 24 with the Lanberg, it is hard to justify paying three times the same price for it as apart from that and protection against fire damage, the cable has the same specifications.

3.3.1.5.2 FIBER CABLE

Product	RS PRO OM4 Multi Mode OM4 Fibre Optic Cable
Category	Multi-Mode (OM4)
Length	100 meters
Core/Cladding Diameter	50/125 μm
Fiber Count	2 cores
Connector Type	LSZH (Low Smoke Zero Halogen)
Application	Floor-to-floor backbone connection
Wavelength	850 nm / 1300 nm
Operating Temperature	-20°C to +70 °C
Warranty	5 years
Price	RM2340.00
Reference	https://my.rs-online.com/web/p/fibre-optic-cable/2149635?cm_mmc=MY-PLA-DS3A--google--PLA_MY_EN_Pmax_RSpro_0623---&matchtype=&&&&&&gad_source=4&gclid=CjwKCAiApsm7BhBZEiwAvIu2X03MW6jiEuKQmyU2ysgGSJoQzUkmIvcvxJ8G3T7P9uMOx6ZY112NzBoC5LYQAvD_BwE&gclsrc=aw.ds



Figure 3.3.1.5.2 shows RS PRO OM4 Multi Mode OM4 Fibre Optic Cable

The **RS PRO OM4 Multi Mode OM4 Fibre Optic Cable** was chosen for its high performance, reliability, and suitability for the faculty's networking needs, particularly for floor-to-floor backbone connections. Its OM4 multi-mode design supports high-speed data transmission over short to medium distances, making it ideal for a building with two floors where data traffic between switches and distribution points must be handled efficiently. The 50/125 μm core/cladding diameter ensures excellent signal quality for applications requiring high bandwidth, such as virtualization, cloud access, and data-intensive workloads. The LSZH (Low Smoke Zero Halogen) jacket enhances safety by reducing toxic emissions in case of fire, meeting stringent indoor safety standards. Additionally, its dual-core design provides redundancy and flexibility for current and future network expansion. With a wavelength range of 850 nm and 1300 nm, this cable supports modern network equipment, ensuring compatibility and scalability. Furthermore, the 5-year warranty and durable build offer a long-term, cost-effective solution for a reliable and robust networking infrastructure in the faculty.

3.3.1.6 MOTION DETECTION CAMERA

Product	Aver DL30 FullHD Webcam
Specification	<p>Image sensor: 1/2.8" 1080p Low Lux CMOS</p> <p>Resolution: Full HD 1080p at 60 frames per second</p> <p>Optical zoom: 12x optical zoom</p> <p>Digital zoom: 2x digital zoom</p> <p>Field of View:</p> <ul style="list-style-type: none">• Diagonal: 84.1° (Wide) to 7.8° (Tele)• Horizontal: 76.5° (Wide) to 6.8° (Tele)• Vertical: 47.3° (Wide) to 3.8° (Tele)
Price	RM4,997.49
Reference	https://www.tradeinn.com/techinn/en/aver-dl30-fullhd-webcam/138715587/p?queryID=2b58c96e6c67b31d8af7bc49bd8514ce&buscador_search



Figure 3.3.1.6 shows Aver DL30 FullHD Webcam

The **Aver DL30 FullHD Webcam** is the perfect choice for a hybrid classroom. The built-in motion tracking feature of that camera focuses on only 1 presenter and will move its head to keep a presenter in its field of view ensuring seamless engagement for both in-person and remote students. Its Full HD 1080p resolution at 60 frames per second provides clear and smooth visuals, while the 12x optical zoom allows it to capture fine details from a distance, making it suitable for classrooms of all sizes. The wide field of view ensures comprehensive coverage of the teaching area, and make it an efficient and practical tool for hybrid teaching setups.

3.3.1.7 PROJECTOR

Product	Epson EB-X51 Business Projector
Specification	Projection technology: 3LCD, RGB liquid crystal shutter Native resolution: XGA (1024 x 768) Brightness: 3800 lumens (both color and white brightness) Contrast ratio: 16000:1 Projection size: 30 to 300 inches Zoom: Manual, 1.2x'
Price	RM2,799.00
Reference	https://wme.my/products/epson-eb-x51-eb-w51-eb-fh52-corporate-portable-projector?_pos=4&_sid=968a14ad9&_ss=r



Figure 3.3.1.7 shows Epson EB-X51 Business Projector

The reason why we chose the **Epson EB-X51 Business Projector** is because it is the ideal choice for equipping all labs in the faculty building due to its reliability, performance, and cost-effectiveness. With a brightness of 3800 lumens, it ensures clear and vivid visuals even in well-lit labs, making it suitable for various teaching and learning activities. Its XGA resolution (1024 x 768) delivers sharp and detailed images, while the projection size range of 30 to 300 inches provides flexibility to accommodate different lab sizes. The high contrast ratio of 16,000:1 enhances clarity, ensuring that text, images, and videos are displayed effectively. Additionally, the manual zoom function simplifies setup, and the built-in speaker offers an immediate audio solution for smaller spaces. At a reasonable price of RM2,799, this projector offers a practical and efficient solution for enhancing the functionality and educational experience in all lab environments.

3.3.1.8 CABLE PLUG

Product	Lanberg PLU-6000 EZ CAT6 Keystone Connector 100 units
Price	RM37.99
Reference	https://www.tradeinn.com/techinn/en/lanberg-plu-6000ez-cat6-keystone-connector-100-units/140627475/p?queryID=d8a4d8c947329bb856e289665694f21b&buscador_search



Figure 3.3.1.8 shows Lanberg PLU-6000 EZ CAT6 Keystone Connector

A cable plug is required to connect a cable to every device as we choose to buy loose cable in a spool. This allows us flexibility in determining the cable length and making the connection cleaner and less messy. The **Lanberg PLU-6000 EZ CAT6 Keystone Connector** 100 units is our plug of choice as it comes in 100 units for RM37.99, which comes out to RM 0.38 per plug, far cheaper than market price which is RM 0.50-RM1.00 per plug

3.3.1.9 WORKSTATION

Product	IDEALTECH Radiance Novice NVIDIA® GeForce RTX™ 3050	LOQ Tower 17IRR9	DELL Inspiron Desktop
Processor	AMD Ryzen 5 5500	Intel Core i5-14400F	Intel Core i5-14400F
Memory	16GB	16GB	16GB
Graphic Cards	NVIDIA Geforce RTX 3050 6GB	NVIDIA Geforce RTX 3050 6GB	NVIDIA Geforce RTX 3050 8GB
Storage	256GB	512GB PCIe SSD	1TB PCIe NVME SSD
Power supply	550W	310W	300W
Price	RM1,998.00	RM3,539.94	RM4,299.00
Reference	https://idealtech.com.my/product/amd-rtx-3050-packagepc/	https://www.lenovo.com/my/en/configurator/cto/index.html?bundleId=90X0CTO1WWMY1	https://www.dell.com/en-my/shop/pcs-desktop-computers/inspiren-desktop/spd/inspiren-3030-desktop/oid3030101701mmy



Figure 3.3.1.9 shows LOQ Tower 17IRR9

The **LOQ Tower 17IRR9** is an ideal option for faculty lab use because of its balanced capabilities, sufficient storage, and affordability, making it suitable for the needs of a professional academic setting. Driven by the Intel Core i5-14400F processor, it provides outstanding multitasking abilities and processing power for activities like programming, database administration, virtualization, and simulations. With 16GB of RAM, it guarantees seamless performance when using several applications or virtual machines at once, and the 512GB PCIe SSD provides quicker read/write speeds for rapid booting and application launches, along with ample storage for software and data sets.

Furthermore, the NVIDIA GeForce RTX 3050 6GB GPU offers sufficient graphical processing capabilities for light to moderate tasks, such as 3D modeling, video rendering, and simulations, making it adaptable for diverse lab activities. With a competitive price of RM3,539.94, it strikes a balance between cost and functionality, providing great value for money while being equipped to adapt to changing needs in the coming years. In comparison to other options, it offers superior storage and updated hardware at an affordable price, making it a perfect choice for setting up a dependable and effective computing lab.

3.3.1.10 TRAINING ROUTER

Product	Cisco 1941
Ports	2x 10/100/1000 Mbps Gigabit Ethernet ports
Throughput	Up to 25-50 Mbps (varies based on features and configurations)
Memory	512 MB DDR2 RAM (expandable), 256 MB flash memory
Power	60 W
Warranty	Limited Lifetime Warranty (with optional Cisco SmartNet support)
Price	RM2699.99
Reference	https://www.sysnapse.com/cisco-1941-sec-k9-replacement-modular-router-cisco1941-sec-k9?gad_source=1&gclid=CjwKCAiApsm7BhBZEiwAvIu2XwMMlcdt7hv4j5ktrC3UsZ4Zc3kmssxzO_MZdOfaPUw4D6xf9y1cOBoCiQQAvD_BwE



Figure 3.3.1.10 shows Cisco 1941 Integrated Services Router (ISR)

The **Cisco 1941 Integrated Services Router (ISR)** was chosen for the Cisco Network Lab due to its versatility, reliability, and relevance for teaching networking concepts. It is an industry-standard device that supports advanced routing protocols like OSPF, EIGRP, and BGP, making it ideal for hands-on training in enterprise networking. The router also provides basic Layer 2 functionality, enabling students to practice VLAN configurations and foundational switching tasks. Its modular design allows for hardware expansions, making it adaptable to various training scenarios, while its throughput of up to 50 Mbps and robust processing power ensure smooth operation in lab environments. Furthermore, the 1941 ISR's familiarity with Cisco IOS prepares students for certifications like CCNA and CCNP, and its limited lifetime warranty ensures long-term reliability. These features, combined with its cost-effectiveness for educational purposes, make it an excellent choice for the lab.

3.3.1.11 TRAINING SWITCH

Product	HP Aruba Instant On 1960 24G 2XGT 2SFP+ 1960 switch
Ports	- 24x 10/100/1000 Mbps Gigabit Ethernet ports - 2x 10GBASE-T ports - 2x 10G SFP+ ports
PoE Support	Not applicable
Switching Capacity	176 Gbps
Throughout	130.95 Mpps
Layer support	Layer 2+
Warranty	Limited Lifetime Warranty
Price	RM2344.99
Reference	https://www.tradeinn.com/techinn/en/hp-aruba-instant-on-1960-24g-2xgt-2sfp--switch/138690299/p?queryID=e38a29c0844bbcbe1779d3c5770ac66f&buscador_search



Figure 3.3.1.11 shows HP Aruba Instant On 1960 24G 2XGT 2SFP+ 1960 switch

Meanwhile, a training switch is also required in the Cisco Network Lab. We chose the **HP Aruba Instant On 1960 24G 2XGT 2SFP+ 1960 switch** for its affordable price and good warranty. Features like PoE are not required here as it is not taught in the classroom,

3.3.1.12 UPS

Product	Eaton 5E 900 G2	Eaton 5E 1200 USB IEC G2 UPS
Power Support	800W	1000W
Price	RM380.99	RM640.99
Reference	https://www.tradeinn.com/techinn/en/eaton-5e-900-g2-ups/140361123/p?queryID=054b2ff2bd2b9cbe9e4f71e666a03848&buscador_search	https://www.tradeinn.com/techinn/en/eaton-5e-1200-usb-iec-g2-ups/140348894/p?queryID=054b2ff2bd2b9cbe9e4f71e666a03848&buscador_search



Figure 3.3.1.12 shows Eaton 5E 1200 USB IEC G2 UPS and Eaton 5E 900 G2

A UPS is designed to protect the devices from power surge or blackout by providing backup power when the main power fails. Here we chose 2 different types of UPS to protect as the power load of each device is different, ensuring efficiency and utmost protection.

The **Eaton 5E 1200 USB IEC G2 UPS** is chosen to protect the router and a switch that will be placed in 1 of the labs. The higher power support will enable it to provide power backup to 2 devices simultaneously. Meanwhile, the **Eaton 5E 900 G2** will be used to protect the other 3 switches that will be placed in the other labs, requiring less power.

3.3.1.13 IOT KITS

Product	Arduino Grove Sensor Kit with Maker UNO (Complete Kit)
Included modulea	<ul style="list-style-type: none">● Grove Base Shield● Grove - LED● Grove - Buzzer● Grove - OLED Display 0.96"● Grove - Button● Grove - Rotary Potentiometer● Grove - Light Sensor● Grove - Sound Sensor● Grove - Temperature & Humidity Sensor● - Grove - Air Pressure Sensor● - Grove - 3-Axis Accelerometer
Price	RM209.40
Reference	https://my.cytron.io/p-arduino-grove-sensor-kit-for-beginner?r=1

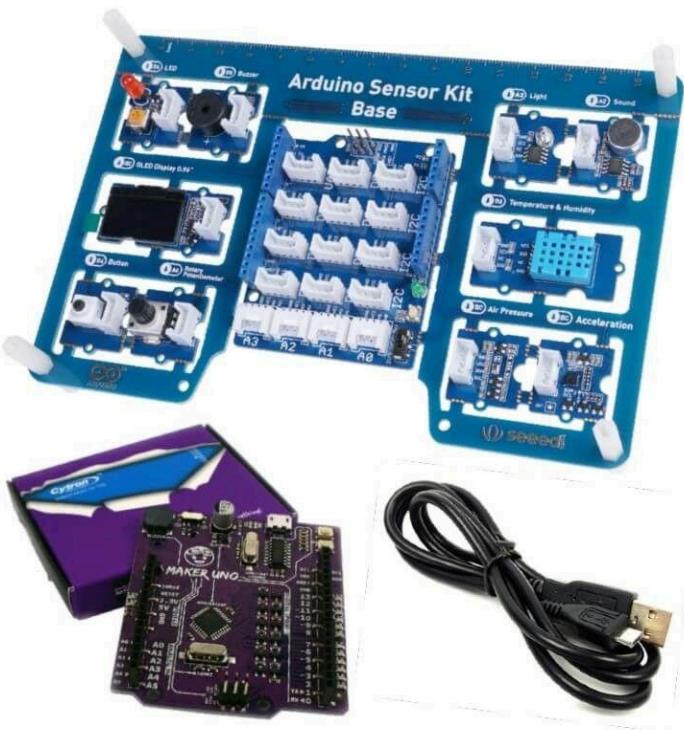


Figure 3.3.1.13 shows Arduino Grove Sensor Kit with Maker UNO (Complete Kit)

The **Arduino Grove Sensor Kit with Maker UNO (Complete Kit)** is perfect to assist the student's learning regarding the Internet Of Things. It will be placed in the Embedded Lab as the students under the guidance of the lecturers embark on the journey of exploring the Internet of Things.

3.3.1.14 VIDEO CONFERENCING SYSTEM

Product	Logitech Rally Plus
Camera	Up to 4K Ultra HD at 30fps, 15x HD zoom, 90° diagonal field of view, Autofocus
Microphones	4 omnidirectional mics with 15 ft range, Acoustic Echo Cancellation, Noise Suppression
Speakers	3" driver, 95-100dB SPL, suspension system to eliminate vibration interference
Hubs	Table and Display Hubs, CAT6A connection (up to 50m), HDMI, USB, RJ45 ports
Compatibility	Certified for Zoom, Skype for Business, Google Meet, WebEx, and more
Key Features	RightLight for optimal video, RightSound for audio clarity, modular with up to 7 mic pods
Dimensions	Camera: 7.19 in x 5.98 in x 5.98 in; Speaker: 17.67 in x 4.05 in x 3.15 in
Warranty	2 years
Price	RM17,950.00
Reference	https://www.logitech.com/en-my/products/video-conferencing/room-solutions/rally-ultra-hd-conferencecam_960-001242.html?srsltid=AfmBOo03QtwUG-pZ0BIU8G4J8PAdG5AzGHO1H-l-XQPaOTHtD7Bnhqrp



Figure 3.3.1.14 shows Logitech Rally Plus

The **Logitech Rally Plus** was chosen because of its outstanding audio-visual features. It has the ability to deliver 4K Ultra HD video and ensures a clear visual even in challenging lighting conditions. The system has 15x HD zoom and 90 degree field of view that will provide a flexibility to cover the large conference rooms. Additionally, the durable build, intuitive plug-and-play setup, and 2-year warranty make it a reliable and future-proof investment for the faculty, enabling high-quality communication and collaboration in a professional environment.

3.3.1.15 TOTAL

Device	Price	Quantity	Price x Quantity
Router	RM 27,629.16	1	RM 27,629.16
Switch	RM 5,597.99	5	RM 27,989.95
Access Point	RM 1,157.00	15	RM 17,355.00
Patch Panel	RM 3,846.65	8	RM 30 773.20
Cable	RM 631.99	8	RM 5,055.92
Fiber Cable	RM 2,340.00	1	RM 2,340.00
Motion Tracking Camera	RM 4,997.49	1	RM 4,997.49
Projector	RM 2,799.00	6	RM 16,794.00
Cable Plug	RM 37.99	7	RM 265.93
Workstation	RM 3,539.94	130	RM 460,192.20
Training router	RM 2,699.99	24	RM 64,799.76
Training switch	RM 2,344.99	24	RM 56,279.76
UPS (800W)	RM 380.99	3	RM 1,142.97
UPS (1000W)	RM 640.99	1	RM 640.99
IOT Kits	RM 209.40	33	RM 6,910.20
Logitech Rally Plus	RM 17,950.00	1	RM 17,950.00
Total Price:			RM 741,116.53

3.3.2 REFLECTION

Completing Task 3 involved extensive research and analysis of LAN devices to meet the requirements of the faculty's network infrastructure. The process highlighted several key insights regarding pricing, cost considerations, and device comparisons.

Were you surprised by the prices? How were you surprised?

Yes, the prices of some devices, especially high-end models from premium brands such as Cisco and Huawei, were unexpectedly high. This was particularly surprising for components like routers and switches, where advanced features such as higher switching capacity and modularity significantly drove up costs. Some of them can cost up to 6 figures for 1 device! On the other hand, more affordable brands like Ruijie and TP-Link provided comparable functionality at a fraction of the cost, which was unexpected and demonstrated the importance of exploring diverse options during the selection process.

Have you ever considered cost as a factor for choosing networking devices?

Cost was a major consideration throughout the selection process. Balancing performance with affordability was critical to ensure that the chosen devices could meet the faculty's requirements without exceeding the allocated budget. For example, while Cisco devices offered unmatched reliability and scalability, the high price made them less feasible for a cost-sensitive academic environment. Instead, we opted for devices like Ruijie switches, which provided sufficient capacity and features while keeping costs manageable.

What are the major differences between the same devices from different brands?

The differences between devices of the same category across various brands were evident in terms of features, warranty, and price. For instance, while Cisco switches offered superior performance with lifetime warranties, Ruijie switches provided comparable functionality with slightly lower capacity and extended warranty periods but at a much lower cost. Similarly, for access points, brands like HPE Aruba offered higher throughput but at a premium price, whereas Ruijie access points provided sufficient performance for the required workload at a more affordable cost. These differences underscored the trade-offs between premium features and budget constraints.

Overall, Task 3 emphasized the importance of balancing technical needs, budget limitations, and future scalability when selecting LAN devices. The exercise not only provided practical insights into device selection but also enhanced our ability to make informed decisions in line with organizational objectives.

3.4 TASK 4

3.4.1 CABLE ARRANGEMENT

3.4.1.1 WORK AREA



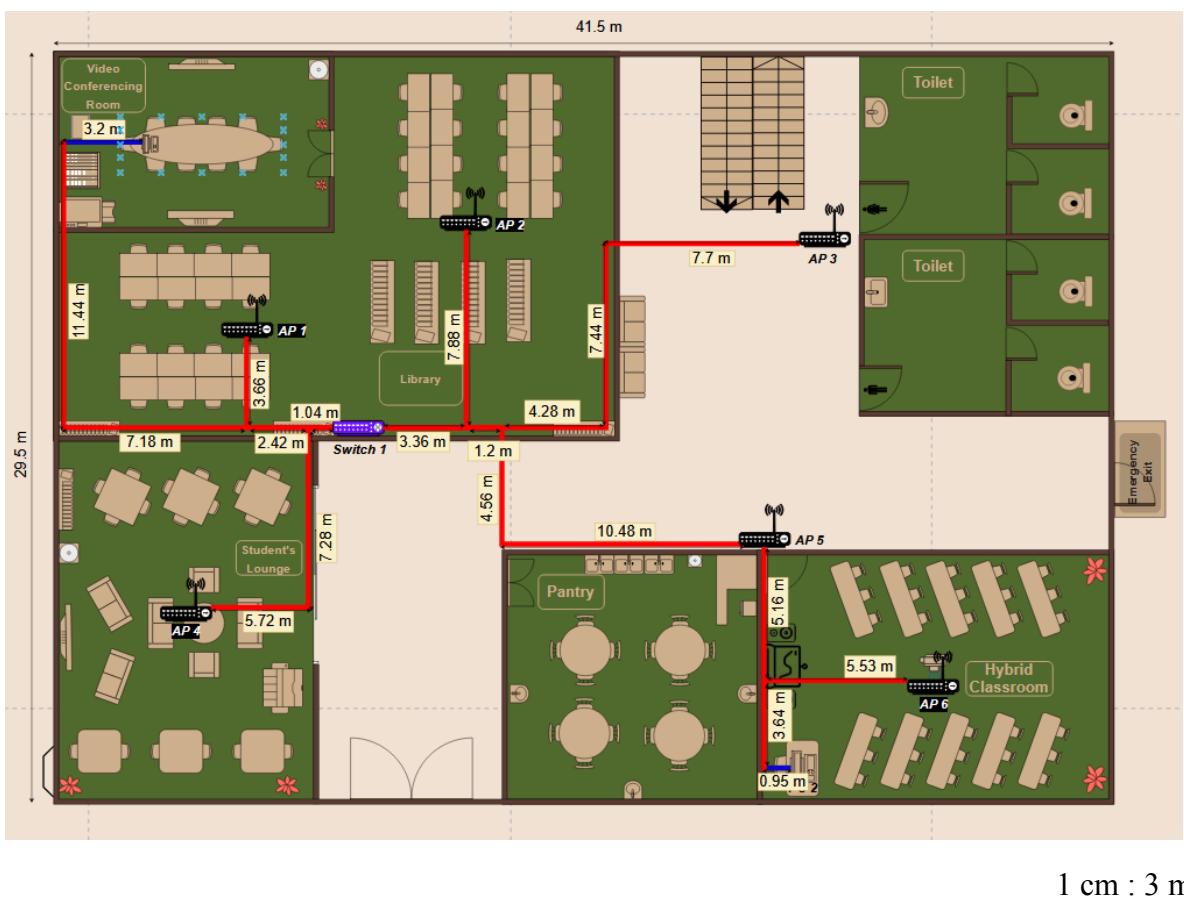
Figure 3.4.1.1 shows the work area of the ground floor



1 cm : 3 m

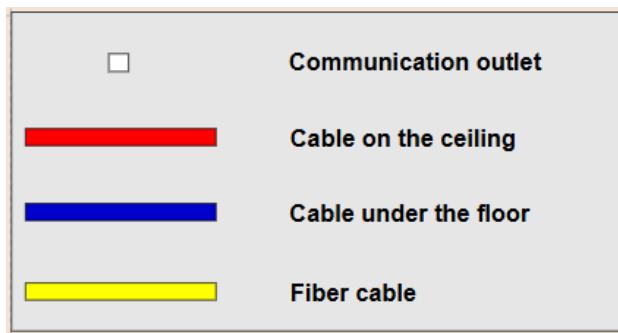
Figure 3.4.1.2 shows the work area of first floor

3.4.1.2 FIRST FLOOR



1 cm : 3 m

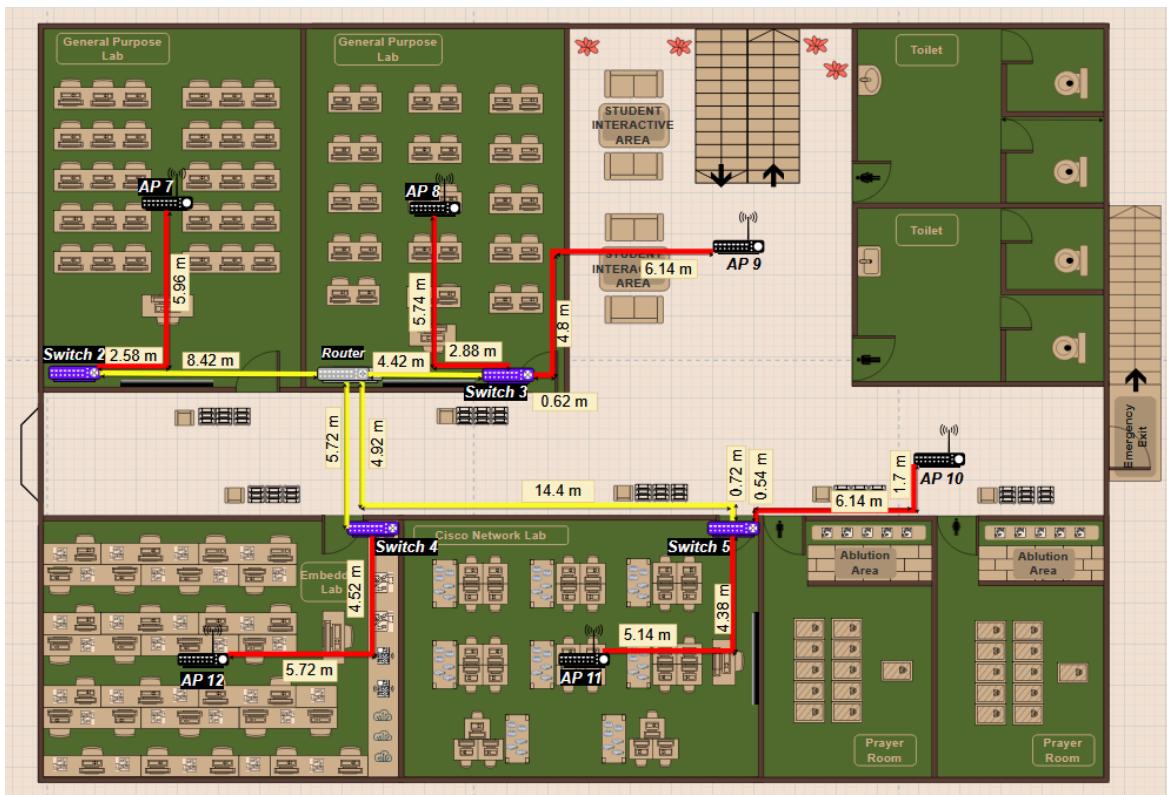
Figure 2.1 shows network arrangement of the first floor



Connection	Cable Length (m)	
	Cat6A	Fiber Optic
PC1 - Switch 1	$3.2 + 2.5 + 11.44 + 7.18 + 2.42 + 1.04 + 0.5 = 28.08$	
PC2 - Switch 1	$3.36 + 1.2 + 4.56 + 10.48 + 5.16 + 3.64 + 3 + 0.95 + 0.5 = 32.65$	
AP1 - Switch 1	$3.66 + 2.42 + 1.04 = 7.12$	
AP2 - Switch 1	$3.36 + 7.88 = 11.24$	
AP3 - Switch 1	$7.7 + 7.44 + 3.36 + 1.2 + 4.28 = 23.98$	
AP4 - Switch 1	$1.04 + 5.72 + 7.28 = 14.04$	
AP5 - Switch 1	$3.36 + 1.2 + 4.56 + 10.48 = 19.6$	
AP6 - Switch 1	$3.36 + 1.2 + 4.56 + 10.48 + 5.16 + 5.53 = 30.29$	
Switch 1 - Router (Second Floor)		4
Total	203.21	4

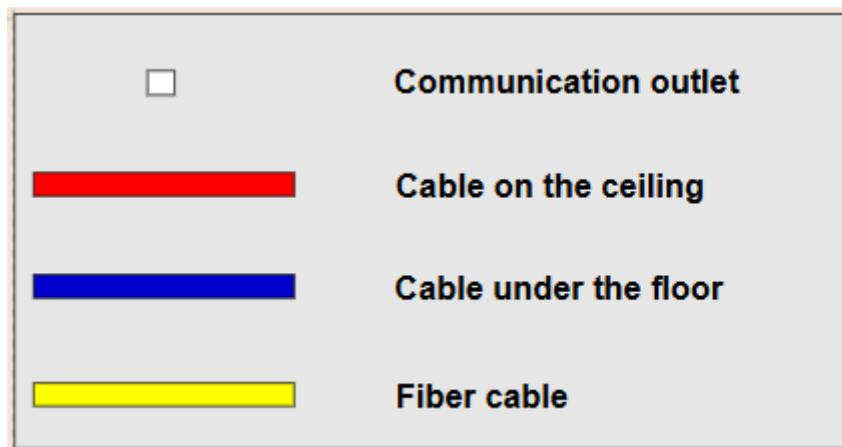
Table 2.1 shows cable length required for the first floor

3.4.1.3 SECOND FLOOR



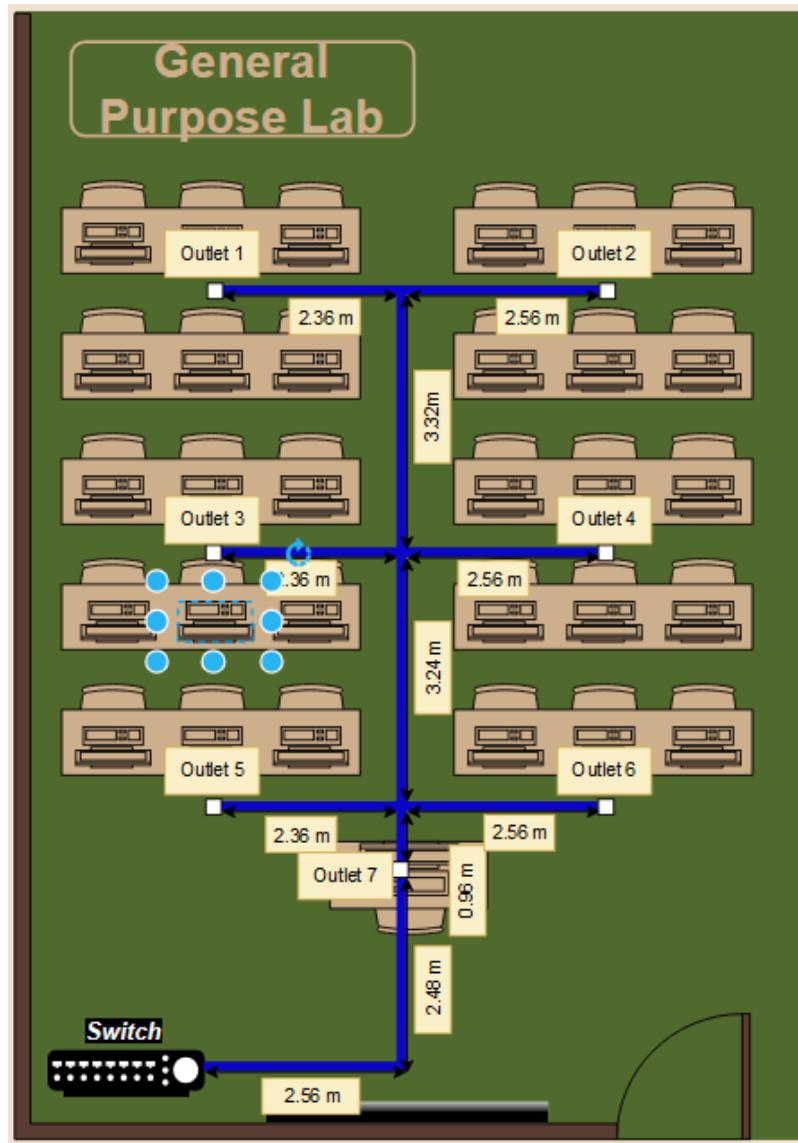
1 cm : 3 m

Figure 2.2 shows network arrangement of the second floor



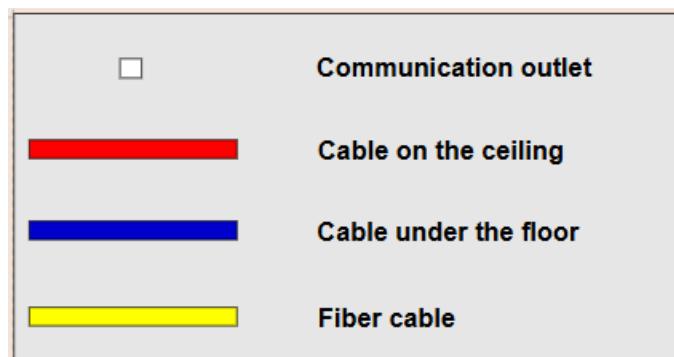
Connection	Length (m)	
	Cat6A	Fibre Optic
Switch 2 - Router		8.42
Switch 3 - Router		4.42
Switch 4 - Router		5.72
Switch 5 - Router		$0.72 + 14.4 + 4.92 = 20.04$
AP7 - Switch 2	$2.58 + 5.96 = 8.54$	
AP8 - Switch 3	$2.88 + 5.74 = 8.62$	
AP9 - Switch 3	$6.14 + 4.8 + 0.62 = 11.56$	
AP10 - Switch 5	$1.7 + 6.4 + 0.54 = 8.64$	
AP11 - Switch 5	$4.38 + 5.14 = 9.52$	
AP12 - Switch 4	$5.72 + 4.52 = 10.24$	
Total	57.12	38.6

3.4.2 GENERAL PURPOSE LAB 1



1 cm : 1 m

Figure 3.4.2 shows network arrangement of the General Purpose Lab 1



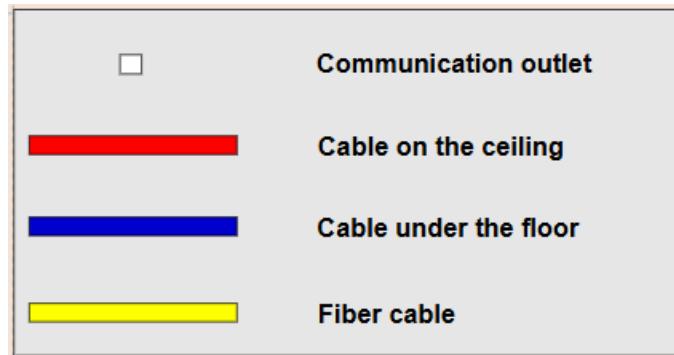
Connection	Cat6A Length (m)
Switch - Outlet 1	$6 * (2.56 + 2.48 + 0.96 + 3.24 + 3.32 + 2.36 + 2.5) = 104.52$
Switch - Outlet 2	$6 * (2.56 + 2.48 + 0.96 + 3.24 + 3.32 + 2.56 + 2.5) = 105.72$
Switch - Outlet 3	$6 * (2.56 + 2.48 + 0.96 + 3.24 + 2.36 + 2.5) = 84.6$
Switch - Outlet 4	$6 * (2.56 + 2.48 + 0.96 + 3.24 + 2.56 + 2.5) = 85.8$
Switch - Outlet 5	$3 * (2.56 + 2.48 + 0.96 + 2.36 + 2.5) = 32.58$
Switch - Outlet 6	$3 * (2.56 + 2.48 + 0.96 + 2.56 + 2.5) = 33.18$
Switch - Outlet 7	$2.48 + 2.56 + 2.5 = 7.54$
Outlet - all PC	$31 * 0.5 = 15.5$
Total	469.44

3.4.3 GENERAL PURPOSE LAB 2



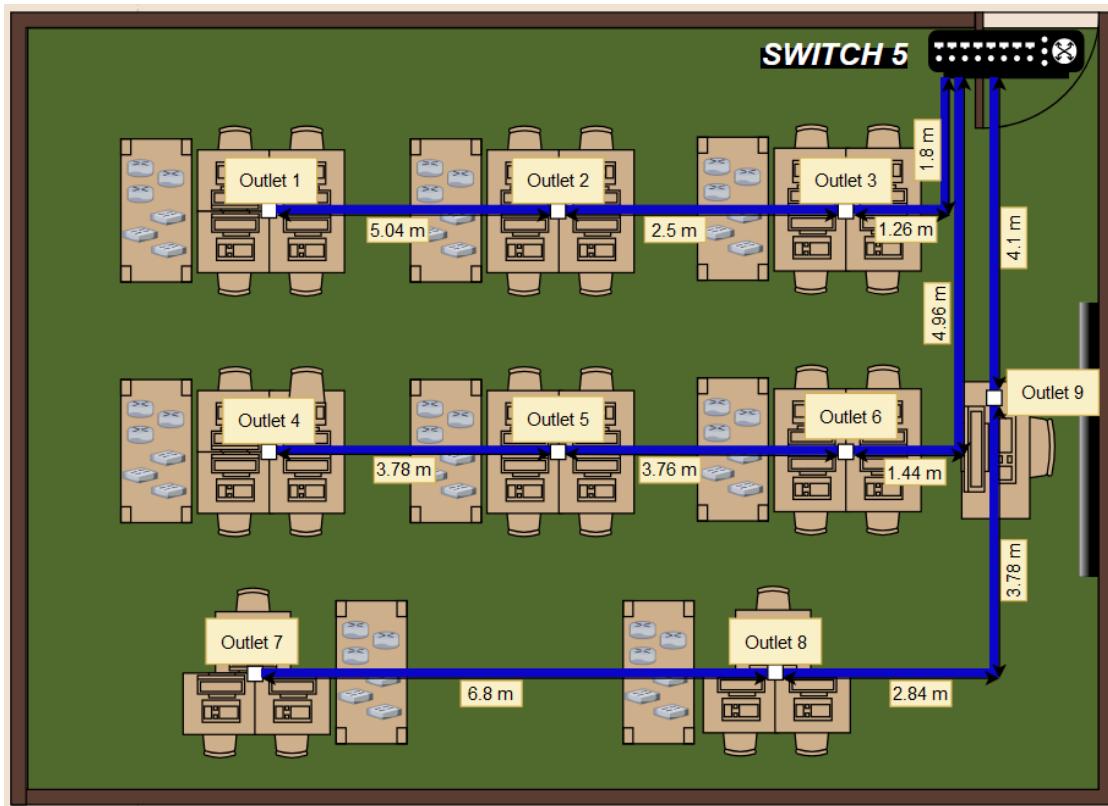
1 cm : 1 m

Figure 3.4.3 shows network arrangement of the General Purpose Lab 2



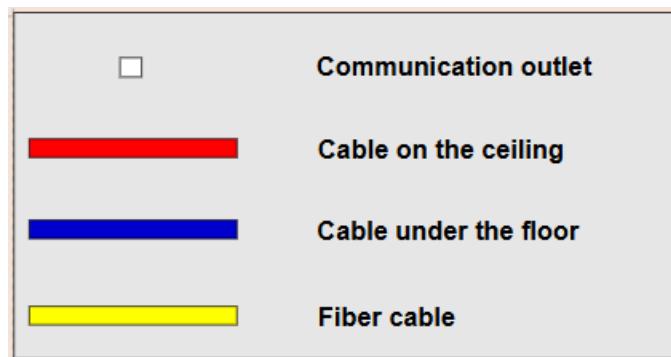
Connection	Cat6A Length (m)
Switch - Outlet 1	$4 * (1.86 + 3.78 + 3.9 + 1.62 + 2.56 + 2.5) = 64.88$
Switch - Outlet 2	$4 * (1.86 + 3.78 + 3.9 + 1.62 + 2.5) = 54.64$
Switch - Outlet 3	$4 * (1.86 + 3.78 + 3.9 + 0.7 + 2.5) = 50.96$
Switch - Outlet 4	$4 * (1.86 + 3.78 + 1.62 + 2.56 + 2.5) = 49.28$
Switch - Outlet 5	$4 * (1.86 + 3.78 + 1.62 + 2.5) = 39.04$
Switch - Outlet 6	$4 * (1.86 + 3.78 + 0.7 + 2.5) = 35.36$
Switch - Outlet 7	$2 * (1.86 + 1.62 + 2.56 + 2.5) = 17.08$
Switch - Outlet 8	$3 * (1.86 + 1.62 + 2.5) = 17.94$
Switch - Outlet 9	$2 * (1.86 + 0.7 + 2.5) = 10.12$
Outlet - all PC	$31 * 0.5 = 15.5$
Total	354.8

3.4.4 CISCO NETWORK LAB



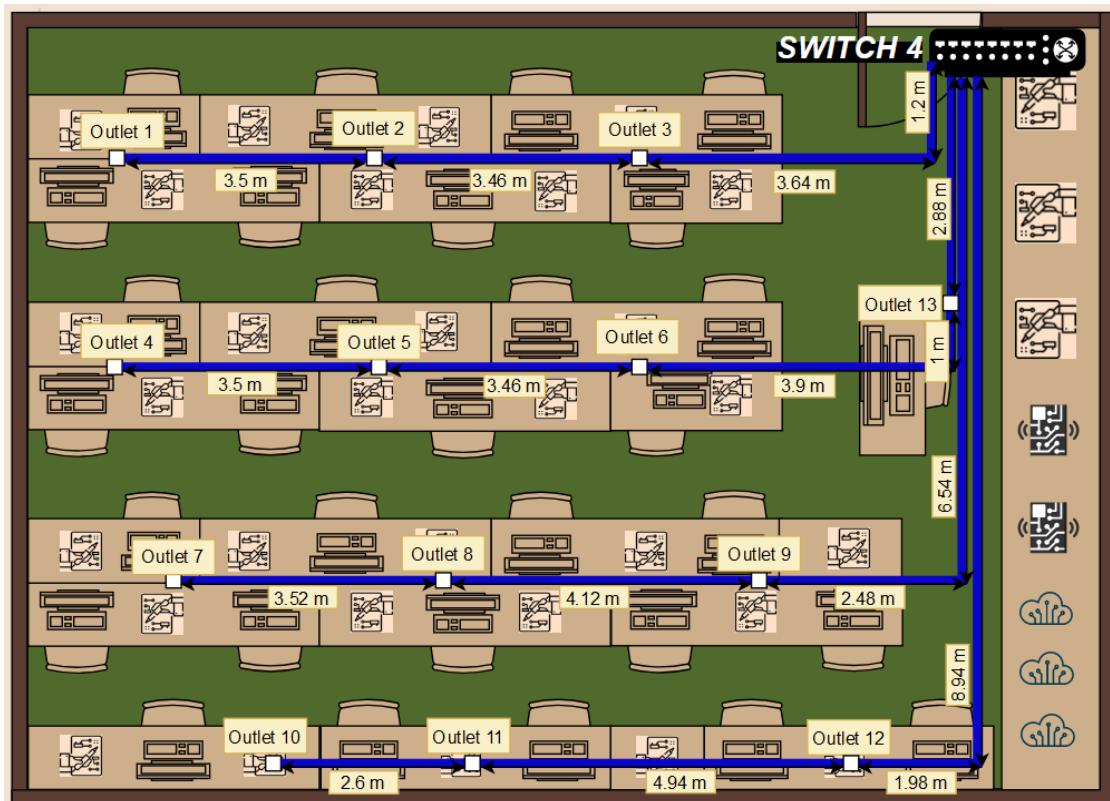
1 cm : 1 m

Figure 3.4.4 shows network arrangement of the Cisco Network lab



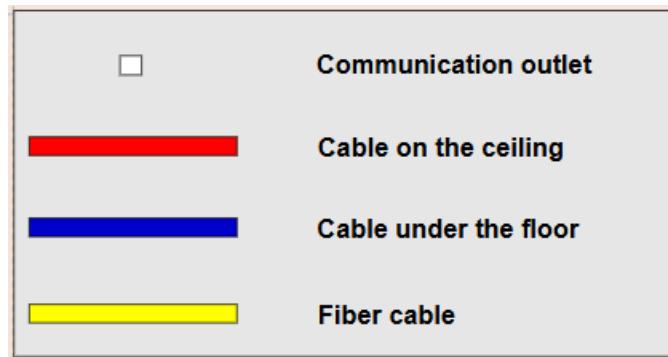
Connection	Cat6A Length (m)
Switch - Outlet 1	$4 * (1.8 + 1.26 + 2.5 + 5.04 + 2.5) = 52.4$
Switch - Outlet 2	$4 * (1.8 + 1.26 + 2.5 + 2.5) = 37.28$
Switch - Outlet 3	$4 * (1.8 + 1.26 + 2.5) = 22.24$
Switch - Outlet 4	$4 * (4.96 + 1.44 + 3.76 + 3.78 + 2.5) = 65.76$
Switch - Outlet 5	$4 * (4.96 + 1.44 + 3.76 + 2.5) = 50.64$
Switch - Outlet 6	$4 * (4.96 + 1.44 + 2.5) = 35.6$
Switch - Outlet 7	$3 * (4.1 + 3.78 + 2.84 + 6.8 + 2.5) = 60.06$
Switch - Outlet 8	$3 * (4.1 + 3.78 + 2.84 + 2.5) = 39.66$
Switch - Outlet 9	$4.1 + 2.5 = 6.6$
Outlet - all PC	$31 * 0.5 = 15.5$
Total	385.74

3.4.5 EMBEDDED LAB



1 cm : 1 m

Figure 3.4.5 shows network arrangement of the Embedded Lab



Connection	Cat6A Length (m)
Switch - Outlet 1	$2 * (1.2 + 3.5 + 3.46 + 3.64 + 2.5) = 28.6$
Switch - Outlet 2	$3 * (1.2 + 3.46 + 3.64 + 2.5) = 32.4$
Switch - Outlet 3	$3 * (1.2 + 3.64 + 2.5) = 22.02$
Switch - Outlet 4	$2 * (2.88 + 1 + 3.9 + 3.46 + 3.5 + 2.5) = 34.44$
Switch - Outlet 5	$3 * (2.88 + 1 + 3.9 + 3.46 + 2.5) = 41.22$
Switch - Outlet 6	$3 * (2.88 + 1 + 3.9 + 2.5) = 30.84$
Switch - Outlet 7	$3 * (6.54 + 2.48 + 4.12 + 3.52 + 2.5) = 57.48$
Switch - Outlet 8	$3 * (6.54 + 2.48 + 4.12 + 2.5) = 46.92$
Switch - Outlet 9	$3 * (6.54 + 2.48 + 2.5) = 34.56$
Switch - Outlet 10	$8.94 + 9.02 + 2.5 = 20.46$
Switch - Outlet 11	$2 * (8.94 + 6.42 + 2.5) = 35.72$
Switch - Outlet 12	$2 * (8.94 + 1.48 + 2.5) = 25.84$
Switch - Outlet 13	$2.86 + 2.5 = 5.36$
Outlet - all PC	$31 * 0.5 = 15.5$
Total	431.36

3.4.6 NUMBER OF DEVICES AND CONNECTION

Area	Length	
	Cat6A	Fiber Optic
First Floor	203.21	4
Second Floor	57.12	38.6
• General Purpose Lab 1	469.44	
• General Purpose Lab 2	354.8	
• Cisco Network Lab	385.74	
• Embedded Lab	431.36	
Total	1901.67	42.6

After calculation, we found out that the required cable length of this project is around 1.9 km for Cat6A cable and 42.6 meter for fiber optic cable.

3.4.7 REFLECTION

Completing Task 4 involved meticulous planning and calculation to address the complexity of cable arrangements and required lengths for a large-scale network installation. The unexpected need for approximately 1.8 km of Cat6A and 42.6 meters of fiber optic cable emphasized the importance of detailed resource planning. Accurate calculations were critical to avoiding shortages of unnecessary expenses, ensuring efficient use of materials. This project highlighted the value of tailored solutions for unique areas like labs and workspaces, as well as the significance of cost-effective planning without compromising quality. Future improvements could include leveraging advanced tools for cable management and network simulation to optimize designs and ensure scalability.

Are you surprised by the required cable length and arrangement complexity?

Yes, we were surprised by the extensive planning and calculations needed for the cable arrangement. The required cable length, approximately 1.8 km of Cat6A and 42.6 meters of fiber optic cable, exceeded our initial expectations. This highlights the importance of detailed network planning for large-scale installations. The intricate connections between switches, access points and devices across various floors and labs added to the complexity.

Have you ever considered the importance of accurate calculations in networking projects?

Absolutely, accurate calculations are critical. Miscalculations could lead to cable shortages or excessive purchases, increasing project costs unnecessarily. By carefully analyzing the connection requirements for each floor and lab, we ensured optimal use of resources. This also allowed us to anticipate and manage potential issues such as minimizing cable lengths to reduce costs and improve efficiency.

What lessons have you learned from comparing network design and cabling needs?

This task 4 emphasized the importance of meticulous design and planning in network installations. Each area such as the General Purpose Lab 1 (529 meters) and Embedded Lab (417.08 meters) demonstrated how usage patterns and physical layouts impact resource needs. In addition , this exercise underscored the value of cost-effective planning. Understanding the differences in material and labor costs for Cat6A and fiber optic cables helped us allocate resources efficiently without compromising quality.

This Task 4 highlighted the importance of precise planning and accurate calculations in large-scale network installations. The unexpected need for 1.8 km of Cat6A and 42.6 meters of fiber optic cable emphasized resource optimization and cost-effective solutions tailored to specific needs. Advanced tools for cable management and simulation could enhance future designs.

3.5 TASK 5

3.5.1 NETWORK ADDRESS INFORMATION

Subnet Mask	Network Address	Broadcast Address	Usable Host IP Address
255.255.240.0	172.25.0.0	172.25.15.255	172.25.0.1 - 172.25.15.254

Binary subnet mask: 11111111.11111111.11110000.00000000

Binary network address: 10101100.00011001.00000000.00000000

Total Number of Hosts: 4096

Total Number of Usable Hosts: 4094

After setting the network and broadcast address, there is still a need to subnet further the network according to different work areas. For ease of calculation, we will do the subnet division according to each switch and its connections. As each switch is connected to a different number and type of devices, we will do variable size subnet division as each switches' requirements for the network are different. For example, connection with an access point will result in a higher number of usable hosts required as it allows many devices to be connected to it at the same time compared to just one for each workstation.

As the maximum number of devices supported by each access point is stated as 100+ instead of a specific number in the product specifications, an assumption is made that the maximum number of users supported by each access point is 199. Thus, each access point contributed around exactly 200 hosts as each access point will also require an IP address. The specific number can also be referred to in Task 4.

Switch	Number of Devices			
	Router	Workstations	Access Point(s)	No of usable hosts required
1	1	2	6	$1 + 1 + 2 + (6 * 200) = 1204$
2		31	1	$31 + (1 * 200) = 232$
3		31	2	$31 + (2 * 200) = 432$
4		31	1	$31 + (1 * 200) = 232$
5		31	2	$31 + (2 * 200) = 432$

3.5.2 RANGE OF IP ADDRESSES, NETWORK AND BROADCAST ADDRESS FOR SUBNET.

Subnet	Area (Number of devices)	No of usable hosts	Range of IP Address	Network Address	Broadcast Address	Subnet Mask
1	First Floor (Router + Switch 1 + AP1-6 + 2 PCs)	1204	172.25.0.1 - 172.25.7.254	172.25.0.0	172.25.7.255	255.255.248.0 /21
2	General Purpose Lab 2 (Switch 3 + AP 8-9 + 31 PCs)	432	172.25.8.1 - 172.25.9.254	172.25.8.0	172.25.9.255	255.255.254.0 /23
3	Cisco Network Lab (Switch 5 + AP 10-11 + 31 PCs)	432	172.25.10.1 - 172.25.11.254	172.25.10.0	172.25.11.255	255.255.254.0 /23
4	General Purpose Lab 1 (Switch 1 + AP 7 + 31 PCs)	232	172.25.12.1 - 172.25.12.254	172.25.12.0	172.25.12.255	255.255.255.0 /24
5	Embedded Lab (Switch 4 + AP 12 + 31 PCs)	232	172.25.13.1 - 172.25.13.254	172.25.13.0	172.25.13.255	255.255.255.0 /24

3.5.3 IP ADDRESS DISTRIBUTION

3.5.3.1 GROUND FLOOR

i) Student Lounge

Host Device	Number of Device	IP Address
Access Point 4	1	172.25.0.8

ii) Hybrid Classroom

Host Device	Number of Device	IP Address
Access Point 5	1	172.25.0.9
Workstation	1	172.25.0.4

iii) Video Conferencing Room & Library

Host Device	Number of Device	IP Address
Access Point 1	1	172.25.0.5
Access Point 2	1	172.25.0.6
Workstation (Conference Room)	1	172.25.0.3
Switch 1	1	172.25.0.2

iv) Corridor

Host Device	Number of Device	IP Address
Access Point 3	1	172.25.0.7
Access Point 6	1	172.25.0.10

3.5.3.2 FIRST FLOOR

i) General Purpose Lab 1

Host Device	Number of Device	IP Address
Switch	1	172.25.12.1
Workstations	31	172.25.12.2 - 172.25.12.32
Access Point 7	1	172.25.12.33

ii) General Purpose Lab 2

Host Device	Number of Device	IP Address
Switch 3	1	172.25.8.1
Workstations	31	172.25.8.2 - 172.25.8.32
Access Point 8	1	172.25.8.33

iii) Embedded Lab

Host Device	Number of Device	IP Address
Switch 4	1	172.25.13.1
Workstation	31	172.25.13.2 - 172.25.13.32
Access Point 12	1	172.25.13.3

iv) Cisco Network Lab

Host Device	Number of Device	IP Address
Switch 5	1	172.25.10.1
Workstation	31	172.25.10.2 - 172.25.10.32
Access Point 10	1	172.25.10.33

v) Corridor

Host Device	Number of Device	IP Address
Access Point 9	1	172.25.8.34
Access Point 11	1	172.25.10.34

3.5.4 REFLECTION

Completing Task 5 necessitated through study and exact planning for subnetting and IP address distributions to guarantee an efficient and scalable network. The complexities of computing binary subnet masks and designating viable hosts for various network segments, such as workstations, access points and routers, highlighted the importance of careful customization. Key takeaways included balancing effective IP address consumption with scalability and customizing subnets to meet unique needs in order to maximize performance while minimizing resource waste. The research emphasized the need of resource optimisation and the possibility for improvement using advanced network modeling tools and redundancy planning.

Are you surprised by the complexity of subnetting and IP address distribution?

Yes , the complexity of subnetting and IP address allocation for this Task 5 was surprising. The detailed calculations such as determining the binary subnet mask and calculating the number of usable host for various network segments, revealed how essential precise planning is for a functional and efficient network. The necessity to consider the varying demands of different areas, such as workstations, access points and routers, added layers of complexity that were unexpected but enlightening.

What lessons were learned from the process of subnet division?

The process of subnet division emphasized the importance of customization in network design. For example, the decision to allocate additional hosts for access points due to their capacity to handle multiple users simultaneously reflects thoughtful network planning. This approach ensures that each subnet is tailored to its specific requirements, optimizing performance and avoiding resource wastage.

Moreover, working with variable sized subnets illustrated the balance between efficient IP address utilisation and scalability. This planning ensures that the network can accommodate future growth without requiring significant restructuring.

How does this Task 5 highlight the importance of resource optimization?

Resource optimization was a recurring theme throughout the project. Allocating IP addresses based on device needs and usage patterns helped minimize waste while ensuring sufficient capacity. For example, the allocation of 1204 hosts of the first-floor subnet and fewer hosts for other areas like the General Purpose Labs demonstrates efficient resource distribution. This strategy reduces the likelihood of network congestion or underutilization.

What would you improve or do differently in the future?

In future projects, incorporating advanced network simulation tools could streamline the planning process and reduce manual calculations. Additionally, gathering more detailed specifications for devices such as precise user capacity for access points, would improve accuracy. Furthermore, building redundancy into the subnet design could enhance network resilience, particularly for critical areas like the Cisco Network Lab and Embedded Lab. This would help maintain functionality in case of unexpected device or connection failures.

This Task 5 underscored the critical role of careful planning and detailed calculations in designing a robust network infrastructure. It provided valuable insights into managing IP address allocation efficiency while ensuring scalability and reliability. The experience will inform future network design projects, fostering more effective and optimized solutions.

4.0 CONCLUSION

In this project, we have successfully designed a scalable network infrastructure for the building by doing research and integrating the newfound knowledge that is obtained in the lectures to a practical application. Through teamwork with other members, we managed to address the current and future networking needs, ensuring the objectives of the project to be met.

We managed to design a sensible floorplan of the new building, do research in setting up a network infrastructure, compare the network devices on the market, plan the cabling required for the network and carry out IP addressing by dividing the network into different subnets.

We managed to work together as a team to carry out all the tasks, dealing with an uncooperative team member, and displaying the theoretical and technical knowledge required in designing a network infrastructure. In addition to that, we also managed to show our research skills to gain knowledge that is not included in the lectures and use our strong problem-solving skills to tackle these tasks and define, create and present complete deliverables that align with the requirements of the project.

As a team, we still lack the cohesion that is displayed by other teams as we didn't know each other before this semester started. One of our team members, Nik, just registered to UTM this year, thus requiring a brief transitional period to adjust himself to UTM life and becoming accustomed to us as a team member and as a good partner. This causes us to clash heads occasionally at the start of the semester, but as the semester goes on, we manage to mesh wonderfully and perform the tasks smoothly, even though we did not have a person that plays the role as team leader between us.

5.0 ADDITIONAL ELEMENTS FOR CLIENT

If the clients agree to commit to additional spending, the quality of the deliverables will unquestionably be much higher, but it can also lead to unnecessary additional spending, as the chosen products become overkill for the clients' requirements. We should also avoid trying to choose the least expensive products for everything, as cheaper products tend to become obsolete faster compared to more expensive ones. The more expensive products also tend to come from reputable network devices providers, which in of itself provide the client with peace of mind as these products usually come with strong warranty policies. The more expensive products also will most of the time adopt the latest technology and able to provide customers with long duration of usability.

Thus, in order to maximize the amount of bang for the buck of the client's money, Cost-Benefit Analysis should be done. This will give the clients a clearer picture on the money spent and the return value that is received from it. For example, the selected router, Juniper MX204-HW-BASE, was chosen over Cisco ASR 1001-X due to its higher throughput (400 Gbps) at a lower price point (RM 27,629.16). While initially more expensive than Mikrotik CCR1072, it offers superior scalability and reliability, reducing long-term maintenance costs.

Next, clients should also be prepared for any potential risks that may derail the network connection of the building such as hardware failure and weather. The UPS is a great example of this, as clients chose to prepare against any hardware failure caused by unexpected weather anomalies by incorporating UPS. This will provide clients with peace of mind, as the UPS will protect the hardware from any power failure and provide valuable time for the clients to save and backup their devices.

6.0 TEAM MEMBERS

NAME	RESPONSIBILITY
WAN MUHAMMAD HAFIZ BIN WAN NOOR AZAM SHAH A23CS3021	<p>TASK 1:</p> <ul style="list-style-type: none"> - General purpose labs - Toilet - Prayer room - Design first floor <p>TASK 2:</p> <ul style="list-style-type: none"> - Introduction - Question 1 and 2 (including answers) <p>TASK 3:</p> <ul style="list-style-type: none"> - Introduction - Switch research - Cable - Training room - Video conferencing room - Total cost calculation <p>TASK 4:</p> <ul style="list-style-type: none"> - Introduction - Floorplan labelling - Network arrangement of the General Purpose Lab 1 and 2 <p>TASK 5:</p> <ul style="list-style-type: none"> - Network address information(description) - Range of IP addresses, network and broadcast address for subnet (subnet 2 and 3) - IP address distribution (General Purpose Lab 1,General Purpose Lab 2 and corridor first floor)
MOHAMAD NASRIN BIN MOHD YUSOFF A23CS3012	<p>TASK 1:</p> <ul style="list-style-type: none"> - Design Embedded Lab - Design Cisco Network Lab - Design stairs and interior outside of lab and room - Scaling all (Lab, Room and each floor) <p>TASK 2:</p> <ul style="list-style-type: none"> - Question 6, Question 7, Question 8, Question 9, Question 10, Question 11 and Question 12 (with answers) - Initial Feasibility study <p>TASK 3:</p> <ul style="list-style-type: none"> - Router

	<ul style="list-style-type: none"> - Motion Detection Camera - Cable Plug - Workstations - Training Router - Training Switch - UPS - IOT Kits <p>TASK 4:</p> <ul style="list-style-type: none"> - Design cable for Embedded Lab - Design connection between room and each floor - Number of devices and connections - Reflection <p>TASK 5:</p> <ul style="list-style-type: none"> - IP address distribution (Embedded Lab and Cisco Network lab) - Range of IP addresses, network and broadcast address for subnet (subnet 4 and 5)
NIK DANISH ADAM BIN FAIRUS B24CS0032	<p>TASK 1:</p> <ul style="list-style-type: none"> - Design Hybrid Classroom - Design Video Conferencing Room - Design Staff's Room - Design Students' Lounge - Design Pantry - Assist in design whole ground floor - Correction ground floor, floor plan(Staff's Room become Library) <p>TASK 2:</p> <ul style="list-style-type: none"> - Question 3, Question 4 and Question 5. (with answers) - Correction for feasibility study (economic, operational and technical) <p>TASK 3:</p> <ul style="list-style-type: none"> - Patch Panel - Access Point - Projector <p>TASK 4:</p> <ul style="list-style-type: none"> - Design cable for Cisco Network Lab - Design cable for Hybrid Classroom - Reflection <p>TASK 5:</p> <ul style="list-style-type: none"> - Introduction - Address distribution (Hybrid Classroom, Student Lounge) - Assist Range of IP addresses, network and broadcast address for

subnet

- Range of IP addresses, network and broadcast address for subnet (no.1)
- Reflection

7.0 REFERENCES

- 0 337 70 | *Legrand LCS3 Series CAT6A 24 Port RJ45 RJ Patch Panel UTP Yellow* | RS. (n.d.-b).
<https://nz.rs-online.com/web/p/rj-patch-panels/1789290?srsltid=AfmBOorB5ONn8v1kc0qrxAs7jghHdddL0f6nvRf6a6sYt07dJFxZ3W6>
- 24-Port *CAT6A Feedthrough Patch Panel RJ45 1U* | Eaton. (n.d.). Eaton Website.
<https://tripplite.eaton.com/24-port-1u-rack-mount-cat6a-feedthrough-patch-panel-rj45-ethernet~N2540246A>
- *Arduino Grove Sensor kit for Beginner*. (n.d.-b). Cytron Technologies Malaysia.
- *Aruba R9B27A Instant on AP25 indoor Access Points, 4x4 Wi-Fi 6 AP*. (n.d.). Network Hardwares.
<https://www.networkhardwares.com/en-my/products/instant-on-ap25-indoor-access-points-r9b27a?variant=41061034328269>
- *AVER DL30 - Distance Learning Tracking Camera* | AVER Global. (n.d.).
<https://presentation.aver.com/model/dl30>
- *AVER DL30 FullHD Webcam Black* | TechINN. (n.d.).
https://www.tradeinn.com/techinn/en/aver-dl30-fullhd-webcam/138715587/p?queryID=2b58c96e6c67b31d8af7bc49bd8514ce&buscador_search
- *CCR1072-1G-8S+* | MikroTik. (n.d.).
<https://mikrotik.com/product/CCR1072-1G-8Splus>
- *Cisco ASR 1000 Series Aggregation Services Routers*. (2024, May 1). Cisco.
<https://www.cisco.com/c/en/us/support/routers/asr-1000-series-aggregation-service-routers/series.html>
- *Cisco Catalyst 2960-X and 2960-XR series switches data sheet*. (2022, June 27). Cisco.
https://www.cisco.com/c/en/us/products/collateral/switches/catalyst-2960-x-series-switches/datasheet_c78-728232.html
- *Cisco Catalyst 2960-X switch 24 ports Black* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/cisco-catalyst-2960-x-switch-24-ports/137972795/p?queryID=0c86d96f66003f5e3fbabf505dc89175&buscador_search
- *Configure your PC* | Lenovo Malaysia. (n.d.).
<https://www.lenovo.com/my/en/configurator/cto/index.html?bundleId=90X0CTO1WWMY1>

- *Dell Inspiron Desktop with the Latest Intel Processors | Dell Malaysia.* (n.d.). Dell. <https://www.dell.com/en-my/shop/pcs-desktop-computers/inspiron-desktop/spd/inspiron-3030-desktop/oid3030101701mmy>
- *Eaton 5E 1200 USB IEC G2 UPS Black | TechINN.* (n.d.).
https://www.tradeinn.com/techinn/en/eaton-5e-1200-usb-iec-g2-ups/140348894/p?queryID=054b2ff2bd2b9cbe9e4f71e666a03848&buscador_search
- *Eaton 5E 900 G2 UPS Black | TechInn.* (n.d.).
https://www.tradeinn.com/techinn/en/eaton-5e-900-g2-ups/140361123/p?queryID=054b2ff2bd2b9cbe9e4f71e666a03848&buscador_search
- *Epson EB-X51 XGA 3LCD Projector.* (n.d.).
<https://www.epson.com.my/Projectors/Corporate-and-Education/Epson-EB-X51-XGA-3LCD-Projector/p/V11H976052>
- *HP Aruba Instant On 1960 24G 2XGT 2SFP+ switch White | Techinn.* (n.d.).
https://www.tradeinn.com/techinn/en/hp-aruba-instant-on-1960-24g-2xgt-2sfp-swtch/138690299/p?queryID=e38a29c0844bbcbc1779d3c5770ac66f&buscador_search
- https://cdnsm5-ss6.sharpschool.com/UserFiles/Servers/Server_20856499/File/Teacher%20Pages/Lindsay%20Dolezal/IT%20Essentials/6.5.pdf
- <https://idealtech.com.my/product/amd-rtx3050-packagepc/>
- <https://lanberg.eu/product/lan-cable-cat-6-utp-305m-solid-cu-grey-fluke-passed-lanberg>
- <https://lanberg.eu/product/rj45-cat-6-utp-plug-8p8c-100pcs-lanberg>
- <https://my.cytron.io/p-arduino-grove-sensor-kit-for-beginner?r=1>
- <https://my.element14.com/eaton-tripp-lite/n254-024/patch-panel-rj45-cat6-6a-24port/dp/2925651?srsltid=AfmBOoqiopn-ucD5vKSErCkyiEQoxQs7DPFqQEDXZUxDAPWIocgB6J9S>
- https://shopee.com.my/product/27503136/21587477544?gads_t_sig=VTJGc2RHVmtYMTIxTFVSVVRrdENkWVp3RFo3Mkw5czd4Z0hzdEF1WVFiblh0RTdoK0hEMWRGdVZ4M1kwVGMrdHROclIIUkN0RDBCMDZ2OUtMcjl4Q01YUEpZRVZrN3N0VIVuMHJBYkN5SDIFKzU2S1hrOXVBUmMxWWpDSnZ3SmI
- https://www.arubainstanton.com/files/DS_WI-FI-6.pdf
- <https://www.arubainstanton.com/products/switches/1960-series/>

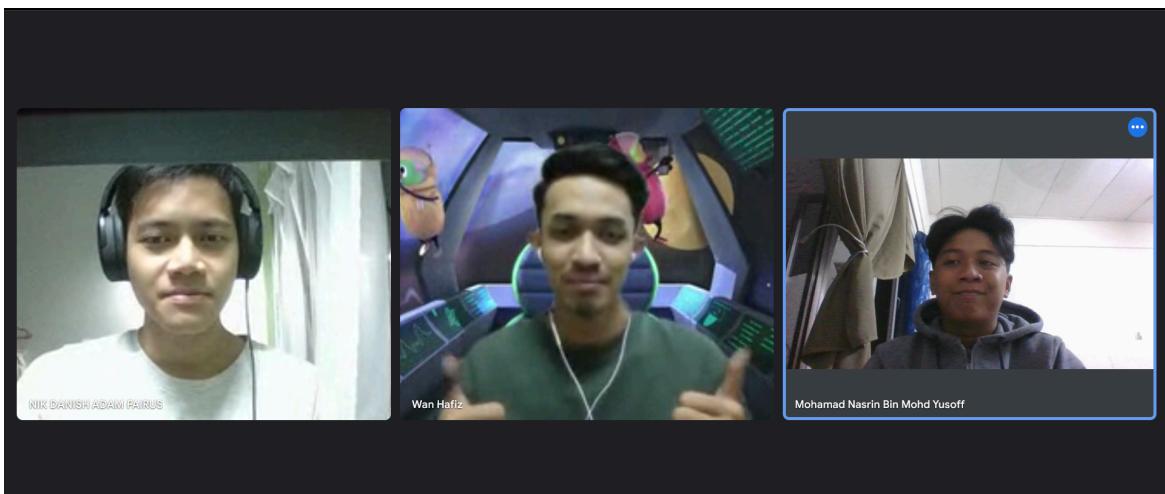
- <https://www.bicsi.org/standards/bicsi-standards/resources/standards-frequently-asked-questions>
- <https://www.cisco.com/c/en/us/support/docs/smb/wireless/cisco-small-business-300-series-wireless-access-points/smb4937-enable-a-captive-portal-on-your-cisco-wireless-network.html> <https://www.ibm.com/topics/network-topology>
- https://www.connection.com/product/tripp-lite-24-port-cat6a-patch-panel-feedthrough-rackmount-rj45-ethernet-1u/n254-024-6a/30657644?srsltid=AfmBOoqU2pFKyzUB9yA_WNqfQZ-1WonWFLKzrNLknTswDH-ws1DEgrg
- <https://www.fcc.gov/consumers/guides/broadband-speed-guide>
- https://www.netforecast.com/wp-content/uploads/NFR5137-Videoconferencing_Internet_Requirements.pdf
- <https://www.router-switch.com/asr1001-x-p-5682.html>
- <https://www.router-switch.com/mikrotik-ccr1072-1g-8s-plus.html>
- <https://www.router-switch.com/mx204-hw-base.html#tab-specification>
- Juniper Networks. (n.d.). *MX204 Universal Routing Platform*. <https://www.juniper.net/us/en/products/routers/mx-series/mx204-universal-routing-platform.html>

- *Lanberg PLU-6000EZ CAT6 Keystone Conector 100 units Clear* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/lanberg-plu-6000ez-cat6-keystone-conector-100-units/140627475/p?queryID=d8a4d8c947329bb856e289665694f21b&buscador_search
- *Lanberg U/Utp CAT6A Reel network cable 305 m Clear* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/lanberg-u-utp-cat6a-reel-network-cable-305-m/139224979/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search
- *Legrand Cat 6A Patch Panel - Google Search*. (n.d.).
<https://www.google.com/search?q=Legrand+Cat+6A+Patch+Panel+>
- Logitech. (n.d.). *Logitech Rally Plus: Ultra-HD conference camera system*.
<https://www.logitech.com/en-my/products/video-conferencing/room-solutions/rally-ultra-hd-conferencecam.960-001242.html>
- *Mikrotik RB1100Dx4 router Silver* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/mikrotik-rb1100dx4-router/140561739/p?queryID=b4db68531c2ee033909bfd7c66894063&buscador_search
- Petrek, J., & Sledt, V. (2001). A large hierarchical network star—star topology design algorithm. *European Transactions on Telecommunications*, 12(6), 511–522.
<https://doi.org/10.1002/ett.4460120607>
- *PNI RJ45 UTP CAT6E network cable 305 m Grey* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/pni-rj45-utp-cat6e-network-cable-305-m/138120232/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search
- *RB1100AHX4 Dude Edition* | MikroTik. (n.d.).
<https://mikrotik.com/product/RB1100Dx4>
- *RG-NBS3100-48GT4SFP-P, 52-Port Gigabit Layer 2 Cloud Managed POE Switch - Ruijie Reyee*. (n.d.).
<https://reyee.ruijie.com/en-global/products/reyee-switch/reyee-access-switches/12-gigabit-cloud-managed-switch/rge-nbs3100-48gt4sfp-p>
- *RG-RAP2260(G) Reyee Wi-Fi 6 AX1800 Ceiling Access Point - Ruijie Reyee*. (n.d.).
<https://reyee.ruijie.com/en-global/products/reyee-wireless/reyee-indoor-ap/rge-rap2260g>
- TP-Link. (n.d.). *JetStream 28-Port Gigabit Smart Switch with 24-Port PoE+*.
<https://www.tp-link.com/my/business-networking/omada-sdn-switch/tl-sg2428p/>
- *TP-LINK TL-SG2428P JetStream 28-Port Gigabit Smart Switch with 24-Port*

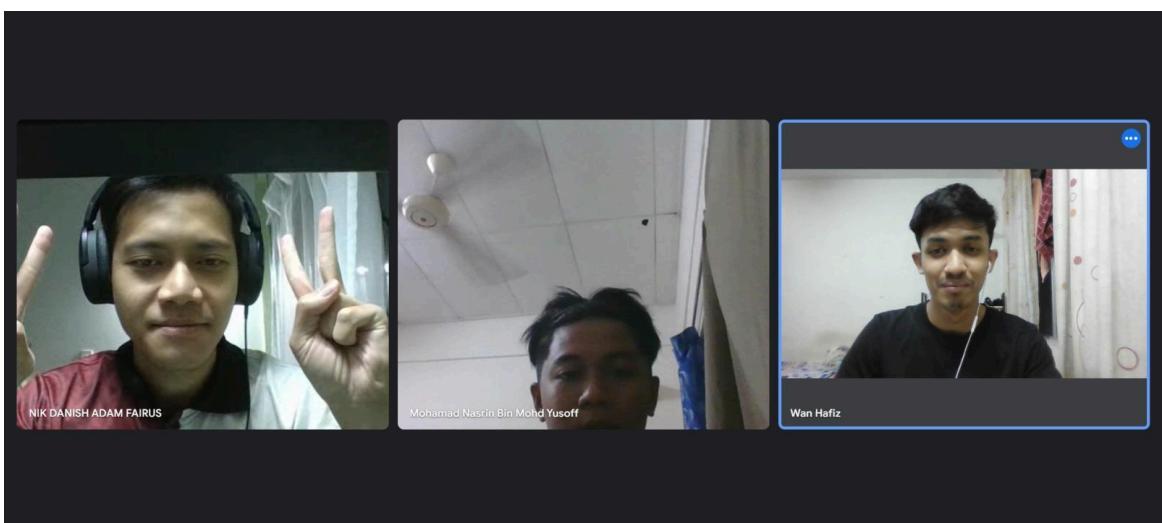
- PoE+ – 2shop by TNT Communications.* (n.d.).
- <https://2shop.com.my/product/tp-link-tl-sg2428p-jetstream-28-port-gigabit-smart-switch-with-24-port-poe/>
- *Ubiquiti UC-C6-CMP CAT6 UTP Reel network cable 305 m White* | Techinn. (n.d.).
https://www.tradeinn.com/techinn/en/ubiquiti-uc-c6-cmp-cat6-utp-reel-network-cable-305-m/138698827/p?queryID=bdef9da56095a1aed21453f728ef994b&buscador_search
 - *Ubiquiti UNIFI U6-Enterprise-Wifi-6 WIFI Access Point White* | TechInn. (n.d.-b).
https://www.tradeinn.com/techinn/en/ubiquiti-unifi-u6-enterprise-wifi-6-wifi-access-point/139546323/p?queryID=95d29befd90928cc38f5407dc24d2579&buscador_search
 - *UniFi Indoor Cable CMP - Ubiquiti Store.* (n.d.). Ubiquiti Store.
<https://store.ui.com/us/en/category/accessories-cables-dacs/collections/accessories-pro-box-cables/products/u-cable-c6-cmp>
 - *UniFi U6 Enterprise - Tech Specs.* (n.d.).
<https://techspecs.ui.com/unifi/wifi/u6-enterprise?s=us>
 - *UTP CAT6 PNI U06 cable with 4 pairs of twisted wires 0.50 mm CCA, for internet and surveillance systems, roll 305m.* (n.d.).
<https://www.mypni.co.uk/utp-cat6-pni-u06-cable-with-4-pairs-of-twisted-wires-0-50-mm-cca-for-internet-and-surveillance-systems-roll-305m.html>
 - wme.my. (n.d.). *Ruijie RG-RAP2260(G) Reyee Wi-Fi 6 AX1800 Ceiling Access Point.*
https://wme.my/products/ruijie-rg-rap2260g-reyee-wi-fi-6-ax1800-ceiling-access-point?_pos=8&_sid=594a51374&_ss=r
 - wme.my. (n.d.-a). *Epson EB-X51 / EB-W51 Business Projector.*
https://wme.my/products/epson-eb-x51-eb-w51-eb-fh52-corporate-portable-projector?_pos=4&_sid=968a14ad9&_ss=r
 - Broadband Speed Guide. (2022, July 18). Federal Communications Commission.
 - Dolezal, L. (n.d.). *IT essentials: Network topologies*. SharpSchool. Retrieved October 31,
 - *Enable a Captive Portal on your Cisco Wireless Network.* (2024, May 1). Cisco.
 - Intel. (n.d.). *What is Wi-Fi 6?* Intel. Retrieved October 31, 2024, from
<https://www.intel.com/content/www/us/en/gaming/resources/wifi-6.html>

- Jones, A., Sevcik, P., & Wetzel, R. (2021). *Internet connection requirements for effective video conferencing to support work from home and eLearning* (NFR5137). NetForecast.
- Jsonmez. (2023, January 12). *5 CRUCIAL PC hardware components programmers NEED to upgrade*. Simple Programmer.
<https://simpleprogrammer.com/best-coding-hardware/>
- Khan, S., Jackson, G., & Goodwin.
<https://www.ibm.com/topics/network-topology>
- Nambiar, R. (n.d.). Wired vs Wireless Internet: Evaluating Pros and Cons. *TATA Play Fiber*.
<https://www.tataplayfiber.com/blog/wired-vs-wireless-internet-evaluating-pros-and-cons>
- Petrek, J., & Sledt, V. (2001). A large hierarchical network star—star topology design algorithm. *European Transactions on Telecommunications*, 12(6), 511–522.
- *Standards frequently asked questions*. (n.d.). Default.
- TP-Link. (n.d.). *TP-Link*. <https://www.tp-link.com/my/wifi6/>
- *What is Client-Server Network? Definition, Advantages, and Disadvantages* - zenarmor.com. (2024, May 8).
<https://www.zenarmor.com/docs/network-basics/what-is-client-server-network>
- Yee, A. (2024, August 7). *Bitdefender Total Security review: Great, easy to use protection*. PCWorld.
<https://www.pcworld.com/article/393363/bitdefender-total-security-review.html>

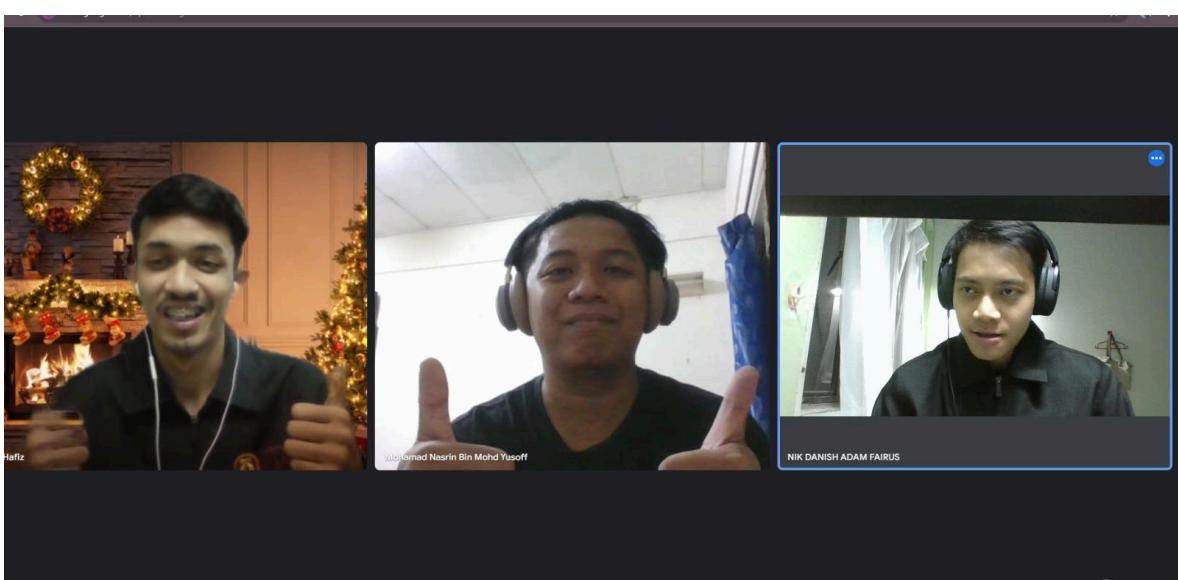
APPENDIX



Picture of First Task 3 Meeting



Picture of First Task 4 Meeting



Picture of First Task 5 Meeting

COST CALCULATION

BUDGET	RM 1,200,000.00
COST	RM 741,116.53
LEFTOVERS	RM 458,883.47

TASK 1

FIRST MEETING

MEETING MINUTES			
DATE/TIME	10 Oct 2024 (21:30)		
LOCATION	Google Meet		
AGENDA	Task 1 Division		
MEETING MC	Mohamad Nasrin Bin Mohd Yusoff		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Mohamad Nasrin Bin Mohd Yusoff		21:30	-
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		21:31	-
Nik Danish Adam Bin Fairus		21:31	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Find group name	Wan suggested "Network Nexus" as a suitable group name to reflect the project's focus on networking and digital spaces. Nasrin and Nik agreed on this choice.	Wan (10/10)
2	Software to use	Nik identified potential software for project planning. After discussion, the team chose draw.io for creating building layouts due to its versatility.	Nik (10/10)
3	Floor design	Wan proposed a floor plan for the building (size: 41.5 m x 29.5 m), including: - 3 classrooms - 2 toilets (one per gender)	Nasrin (10/10)

		<ul style="list-style-type: none"> - 2 prayer rooms - Emergency staircases. <p>Nasrin and Nik agreed to the plan with minor adjustments.</p>	
4	Task division	<p>The team divided tasks:</p> <ul style="list-style-type: none"> - Wan: Design General Purpose Labs. - Nik: Design hybrid classroom & student lounge. - Nasrin: Setup Cisco Network Lab, Video Conferencing Room, and Embedded Lab. <p>Team to review and finalize the overall design collaboratively.</p> <p>Assigned Date: 10/10/2024 Due date: 12/10/2024 Submission date: 12/10/2024</p>	Wan (10/10)
6	Meeting ended	<p>The meeting concluded with agreement on deadlines. The team confirmed to review all components before the next review session.</p>	

SECOND MEETING

MEETING MINUTES			
DATE/TIME		12 Oct 2024 (21:30)	
LOCATION		Google Meet	
AGENDA		Building design and finalization	
MEETING MC		Mohamad Nasrin Bin Mohd Yusoff	
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Mohamad Nasrin Bin Mohd Yusoff		21:30	-
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		21:31	-
Nik Danish Adam Bin Fairus		21:31	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Checking each other's work	The team reviewed each other's designs to identify areas for improvement. Wan noted that some sections needed additional labelling for clarity. Nasrin suggested enhancing the flow between spaces.	Wan (12/10)
2	Layout decision	Nik proposed an optimized layout that includes spacious corridors to accommodate the expected growth in student and staff numbers. The team agreed to adjust room placements for better accessibility.	Nik (12/10)
3	Additional floor design	Nasrin identified leftover spaces in the initial plan and suggested adding a room for academic staff and a pantry for convenience. This change	Nasrin (12/10)

		was agreed upon to better utilize the remaining areas.	
4	Scaling adjustments	Nasrin applied proper scales to the floor plan to provide a more accurate visualization. Nik and Wan reviewed and confirmed the scales for consistency with the initial requirements.	Nasrin (12/10)
5	Finalization	The team discussed the final aspects of the design and confirmed that all modifications were in line with the project goals. Wan prepared the final project report for submission.	Wan (12/10)
6	Meeting ended	The meeting concluded with all members agreeing on the final deadlines. The team will collaborate through WhatsApp to review and refine all components in the shared document before the submission date	

TASK 2**FIRST MEETING**

MEETING MINUTES			
DATE/TIME	28 Oct 2024 (16:00)		
LOCATION	Google Meet		
AGENDA	Task 2		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		16:00	-
Nik Danish Adam Bin Fairus		16:01	-
Mohamad Nasrin Bin Yusoff		16:02	-
Mohamed Ali		16.02	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	
1	Questions	We all discuss and brainstorm the possible questions that should be asked to inquire more information regarding this task.	
2	Research	We do some research on all the questions that we have decided.	

SECOND MEETING

MEETING MINUTES			
DATE/TIME	29 Oct 2024 (15:00)		
LOCATION	Google Meet		
AGENDA	Task 2: Review & Feasibility Analysis		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		15:00	-
Nik Danish Adam Bin Fairus		15:00	-
Mohamad Nasrin Bin Yusoff		15:00	-
Mohamed Ali		15:01	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE

1	Answers	The team collaboratively reviewed the questions previously assigned. Based on the research conducted, each member presented their findings to finalise answers. Nik took the lead in organising the answers to ensure they are clear, concise, and aligned with the project objectives. (Ali late submission)	All (29/10)
2	Feasibility Study	Nasrin and Wan conducted an analysis of the project's feasibility, focusing on factors such as budget, resource allocation, and timeline. They discussed potential risks and mitigation strategies, ensuring the project remains on schedule. The study also covered the technical feasibility of implementing the solutions derived from the research.	All (29/10)

TASK 3

MEETING MINUTES			
DATE/TIME	27/10/2024		
LOCATION	Google Meet		
AGENDA	Task 3		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		16:00	-
Nik Danish Adam Bin Fairus		16:01	-
Mohamad Nasrin Bin Yusoff		16:02	-
Mohamed Ali		-	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Task discussion	<ul style="list-style-type: none"> • The team reviewed the requirements for Task 3, focusing on selecting and documenting the appropriate LAN devices needed to establish a reliable network infrastructure for the faculty building. • Discussed deliverables, including a list of devices, justifications for selection, and reflections on costs and brand comparisons. 	All except Ali (27/10)

2	Research assignment	<p>Members agreed to divide the research tasks:</p> <ul style="list-style-type: none"> ● Wan: Research on switches, cables training rooms, video conferencing room and total cost calculation ● Nik: Research on patch panels, access points and projectors. Cost analysis and comparison of brands. ● Nasrin: Research on router, motion detection camera, cable plug, workstations, training router, training switch, UPS, IOT Kits 	All except Ali (28/10)
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SECOND MEETING

MEETING MINUTES			
DATE/TIME	28/10		
LOCATION	Google Meet		
AGENDA	Task 3		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		15:00	-
Nik Danish Adam Bin Fairus		15:00	-
Mohamad Nasrin Bin Yusoff		15:00	-
Mohamed Ali		-	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Review of research findings	<ul style="list-style-type: none"> ● Each member presented their findings on the assigned devices, highlighting specifications, costs, and suitability for the faculty's needs. ● Nasrin compiled all data into a draft report for submission. 	All (28/10)

2	Device selection finalization	<ul style="list-style-type: none"> ● The team finalized the list of devices based on research and aligned them with the requirements outlined in the task. ● Members ensured all chosen devices had proper justifications, relevant references, and appropriate cost considerations. 	All except Ali (29/10)
3	Reflection points discussion	<ul style="list-style-type: none"> ● Discussed cost surprises and how they influenced the device selection process. ● Compared differences between similar devices from different brands, emphasizing quality, warranty, and long-term value. 	All except Ali

TASK 4**FIRST MEETING**

MEETING MINUTES			
DATE/TIME	12/12/2024		
LOCATION	Google Meet		
AGENDA	Task 4		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		16:00	-
Nik Danish Adam Bin Fairus		16:01	-
Mohamad Nasrin Bin Yusoff		16:02	-
Mohamed Ali		-	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Understanding Assignment	<ul style="list-style-type: none"> The team reviewed the requirements for Assignment 4. Focused on identifying deliverables: cable types, network layout sketches, and planning cabling requirements. 	All except Ali (12/12/2024)
2	Task Assignment	<ul style="list-style-type: none"> Tasks were divided: Wan to handle cable type research and identify work areas and do cabling for General Purpose Lab 1 and 2 , Nik to do cabling on the hybrid 	All except Ali (12/12/2024)

		<p>classroom and Cisco Network Lab, and Nasrin to plan switch port allocation and do cabling on the Embedded Lab, plan connection between room and each floor, calculate the number of devices and connection.</p> <ul style="list-style-type: none"> • Nasrin and Nik compile reflection together 	
3	Tools & Software	<ul style="list-style-type: none"> • Discussed using draw.io for sketches and Google Sheets for cable length and cost tracking. 	All except Ali (12/12/2024)

SECOND MEETING

MEETING MINUTES			
DATE/TIME	13/12/2024		
LOCATION	Google Meet		
AGENDA	Task 4		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		15:00	-
Nik Danish Adam Bin Fairus		15:00	-
Mohamad Nasrin Bin Yusoff		15:00	-
Mohamed Ali		-	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Progress Check	<ul style="list-style-type: none"> • Team members updated their progress. Wan shared cable research, Nik presented the sketches, and Nasrin explained calculations for cable lengths. 	All except Ali (13/12/2024)

2	Sketch Revision	<ul style="list-style-type: none"> Sketches were reviewed, and additional labels were suggested for clarity. Group decided to add a detailed legend for better understanding. 	All except Ali (13/12/2024)
3	Cable Selection	<ul style="list-style-type: none"> Finalized the use of Category 6A cables for horizontal cabling and fiber optic cables for backbone connections due to their high speed and scalability. 	All except Ali (13/12/2024)

TASK 5

FIRST MEETING

MEETING MINUTES			
DATE/TIME	25/12/2024		
LOCATION	Google Meet		
AGENDA	Task 5		
MEETING MC	Mohamad Nasrin Bin Yusoff		
ATTENDANCE			
NAME	TIME	REASON FOR ABSENCE	
Wan Muhammad Hafiz Bin Wan Noor Azam Shah	13:01	-	
Nik Danish Adam Bin Fairus	13:01	-	
Mohamad Nasrin Bin Yusoff	13:00	-	
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Task breakdown	<p>Assigning responsibilities for IP allocation:</p> <ul style="list-style-type: none"> • Hafiz: Subnetting for general-purpose labs • Nasrin: Subnetting for Embedded lab, Cisco Network lab and both floors. • Danish: Addressing for hybrid classrooms and lounges. 	All (25/12)
2	Planning for task 5	<ul style="list-style-type: none"> • Discussed obtaining the assigned network address from the lecturer and brainstormed the best approach to divide the subnet. 	All (25/12)

3	Subnetting	<ul style="list-style-type: none"> Began outlining the logical distribution of subnets for different rooms and labs, ensuring efficiency and clarity in addressing. 	All (25/12)
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SECOND MEETING

MEETING MINUTES			
DATE/TIME	28/12/2024		
LOCATION	Google Meet		
AGENDA	Task 5		
MEETING MC	Wan Muhammad Hafiz Bin Wan Noor Azam Shah		
ATTENDANCE			
NAME		TIME	REASON FOR ABSENCE
Wan Muhammad Hafiz Bin Wan Noor Azam Shah		15:00	-
Nik Danish Adam Bin Fairus		15:00	-
Mohamad Nasrin Bin Yusoff		15:00	-
MINUTES			
NO.	ITEMS	IDEAS/SUGGESTIONS	PERSON IN CHARGE & DATE
1	Network Address	<ul style="list-style-type: none"> Reviewed the addressing plan with the group. 	All (28/12)
2	Subnetting Plan	<ul style="list-style-type: none"> Finalized the division of the subnet for all rooms and labs, ensuring no overlap or conflicts in IP addresses. 	All (28/12)
3	Final Adjustment	<ul style="list-style-type: none"> Discussed and refined subnetting decisions to ensure logical and efficient network structure 	All (28/12)